JANUARY, 1958

modern castings

CASTINGS MEET THE CHALLENGE OF SPACE AND SPEED

4 Technical Articles Reveal a World of Opportunities for Metal Castings

The Foundrymans Own Magazine

Steel for Missiles p. 26

Chance Vought Aircraft leads their industry in using steel castings in planes and missiles

Castings Guide Radar p. 29

Precision cast wave guides require ingenuity to produce complex internal cored cavities

Aluminum for Aircraft p. 32

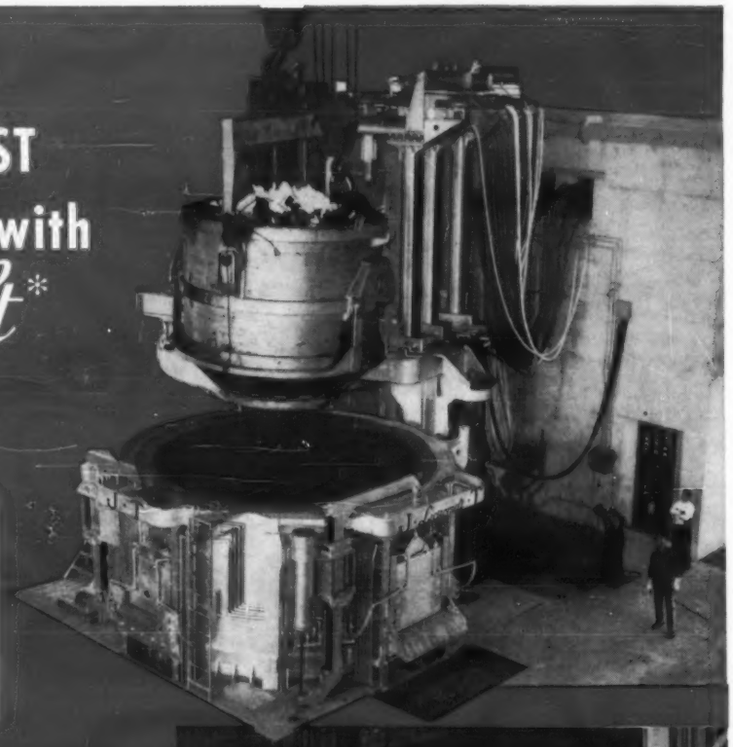
Howard Foundry builds quality into castings by close control of every operation in foundry

Moving the Earth p. 64

Caterpillar Tractor Co. uses castings to solve problem of more power per lb of machine

2 NEW features { AFS NEWS / 1958 TRANSACTIONS PREVIEW

WORK GOES FAST and SMOOTHLY with *Lectromelt** FURNACES



Right: Labor-saving top charging lets a Lectromelt Furnace get to work *fast*.

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Lectromelt's hydraulic tilting mechanism provides positive, easily controlled, trouble-free operation.

For Catalog No. 10 giving more details, write Lectromelt Furnace Division, McGraw-Edison Co., 316 32nd St., Pittsburgh 30, Pa.

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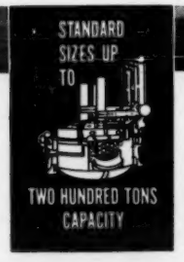

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future meetings and exhibits

JANUARY

13-17 . . Society of Automotive Engineers, *Annual Meeting*. Sheraton-Cadillac and Statler Hotels, Detroit.

17 . . Malleable Founders' Society, *Semi-annual Meeting*. Hotel Cleveland, Cleveland.

27-28 . . Industrial Heating Equipment Association, *Annual Meeting*. Penn-Sheraton Hotel, Pittsburgh, Pa.

27-30 . . *Plant Maintenance & Engineering Show*. International Amphitheatre, Chicago.

30-31 . . American Society for Engineering Education, *College-Industry Conference*. University of Michigan, Ann Arbor, Mich.

FEBRUARY

6-7 . . Malleable Founders' Society, *Technical & Operating Conference*. Wade Park Manor, Cleveland.

10-14 . . American Society for Testing Materials, *Committee Week*. Hotel Statler, St. Louis.

13-14 . . AFS *Wisconsin Regional Foundry Conference*. Hotel Schroeder, Milwaukee.

16-20 . . American Institute of Mining, Metallurgical & Petroleum Engineers, *Annual Meeting*. Hotels Statler and Sheraton-McAlpin, New York.

20-21 . . AFS *Southeastern Regional Foundry Conference*. Patten Hotel, Chattanooga, Tenn.

24-25 . . AFS Board of Directors, *Annual Meeting*. Ponte Vedra Hotel, Ponte Vedra Beach, Fla.

28 . . Malleable Founders' Society, *Western Section Meeting*. Drake Hotel, Chicago.

MARCH

12-13 . . Foundry Educational Foundation, *College-Industry Conference*. Statler Hotel, Cleveland.

17-18 . . Steel Founders' Society of America, *Annual Meeting*. Drake Hotel, Chicago.

APRIL

13-18 . . American Chemical Society, *Spring Meeting*. San Francisco.

14-16 . . American Institute of Mining, Metallurgical & Petroleum Engineers, *41st National Open Hearth Steel Conference*. Statler Hotel, Cleveland.

14-18 . . American Welding Society, *Annual Meeting and 6th Welding Show*. Kiel Auditorium and Statler Hotel, St. Louis.

27-May 1 . . American Ceramic Society, Inc., *Annual Meeting*. Penn-Sheraton Hotel, Pittsburgh, Pa.

MAY

1-8 . . American Soicety of Tool Engineers, *26th Annual Meeting & Convention*. Convention Center, Philadelphia.

12-16 . . American Society For Metals, *1st Southwestern Metal Congress & Exposition*. State Fair Park, Dallas, Texas.

19-23 . . American Foundrymen's Society, *62d Annual Castings Congress & Foundry Show*. Public Auditorium, Cleveland.

JUNE

9-10 . . Malleable Founders' Society, *Annual Meeting*. The Homestead, Hot Springs, Virginia.

12-13 . . AFS *15th Annual Chapter Officers Conference*. Hotel Sherman, Chicago.

19-21 . . AFS *3d Annual Foundry Instructors Seminar*. Case Institute of Technology, Cleveland.

22-28 . . American Society for Testing Materials. *61st Annual Meeting*. Hotel Statler, Boston.

F.E.F. Meeting Features Research and Education

■ Members of the Foundry Educational Foundation University Advisory Committee focused their attention on engineering education and research problems at their recent meeting at the University of Wisconsin.

The F.E.F. group met with faculty members of the university's College of Engineering. Fourteen scholarships of $300 to $450 were awarded by the foundation to university of Wisconsin undergraduate students of engineering.

Twelve industries, located mainly in Wisconsin, were represented by F.E.F. members attending the meeting: E. S. Roth, Motor Castings Co., Milwaukee,; F.E.F. executive director, E. J. Walsh, Cleveland,; C. V. Nass, Beardsley & Piper Co., Chicago; James Ewens, Grede Foundries, Milwaukee; E. O. Jones, Belle City Malleable Co., Racine, Wis.

R. D. Stair, General Malleable Co., Waukesha, Wis.; William MacNeil, Badger Malleable Co., South Milwaukee, Wis.; Alfred Pfeiffer, Allis-Chalmers Mfg. Co., West Allis, Wis.; J. A. Gitzen, Delta Oil Co., Milwaukee; Norman Amrhein, Federal Malleable Co., West Allis, Wis.; J. P. Keating, Neenah, Wis.; A. T. Salz, Gisholt Co., Madison, Wis.; and John Olle, Motor Castings Co., Milwaukee.

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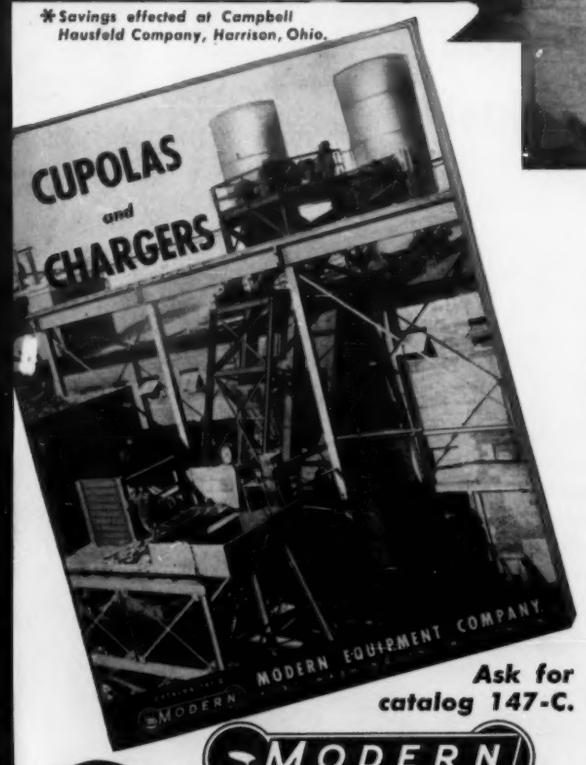
*Savings effected at Campbell Hausfeld Company, Harrison, Ohio.



Ask for catalog 147-C.

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A good start on foundry mechanization — and lowered tonnage costs — frequently involves the removal of an obsolete elevator and the installation of pit, scale and skip charger.

Automatic cycling, between pit and cupola, saves the time that otherwise is wasted in traveling up and down. While one charge is on its way up another charge is made up. Time is made available, too, for over-all, more accurate metallurgical control. Coke costs come down. Quality of the castings goes up. Sales increase and the cycle repeats.

As a good starting place in your own, cost-cutting and sales building program ask for charger catalog 147-C. The catalog shows a size and type of charger for every foundry need.

MODERN EQUIPMENT CO., Dept. M-1, Port Washington, Wis.

- ☐ Catalog 147-C on charging and melting . . .
- ☐ Catalog 150 on cranes and monorail systems . . .
- ☐ Catalog P-152-A on ladles and pouring . . .

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MY NAME .....

Progressive Foundries are Modernizing Their Plants

BY HERBERT F. SCOBIE / *Executive Secretary Non-Ferrous Founders' Society Evanston, Ill.*

■ The active, growing castings industry is quick to adapt to new advances in technique and equipment. New and improved products as well as modern methods of operation are speeding production and increasing profits.

As you know, a strainer core functions as a control over rate of metal flow, not as a screen to keep out unwanted debris. Instead of making them out of sand, or using ceramic strainers, a number of West Coast and Middle West foundries are using mica strainer cores. These have obvious storage and handling advantages and create no problems in remelting gates. They are being used in gray iron, brass, bronze, and aluminum. When used with aluminum, there is no iron pickup such as might occur with perforated metal strainers.

Core Box Erosion

Although core blowing increases production, there are a few headaches connected with the process. One of these is wear under the blow holes. You have probably used expensive metal or synthetic rubber inserts. A new development seems to solve this problem quickly and at low cost—a protective plastic patch with a pressure sensitive adhesive, looking like a band-aid, and coming in various shapes and sizes. The patches are reported to withstand 5000 blows at 135 psi. Material fits most complex contours, sand will not stick to it, and it is not harmfully affected by most cleaning compounds.

Good Housekeeping

It is encouraging to note new trends in thinking that will not only improve our future, but guarantee it against the inroads of competitive processes.

Better foundry housekeeping is one of the trends. Few of us devote as much energy to good housekeeping, or *good shopkeeping*, as we do to making good castings, but we all realize its advantages. We can not go too far in good shopkeeping, because in that direction lies: better morale, increased efficiency, reduced safety hazards, and easier procurement of better workers. Better customer relations are also an important factor.

■ *Condensed from a talk presented at the AFS Missouri Valley Regional Foundry Conference, Sept. 27, 1957.*

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january, 1958
vol. 33, no. 1

modern castings

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MEETING THE CHALLENGE

This issue of MODERN CASTINGS has as its theme—*Castings Meet Challenge of Space and Speed.* Feature articles in subsequent pages show you HOW the castings' industry is meeting this challenge. Many foundrymen fail to realize that their industry has made significant contributions to this new era of technology; that a new element of urgency requires even greater participation in a program that needs tomorrow's castings, today.

Design engineers are realizing at long last the capabilities of castings and are putting them to work. Metalcasting men are accepting the challenge and proving that castings can do a better job at less cost.

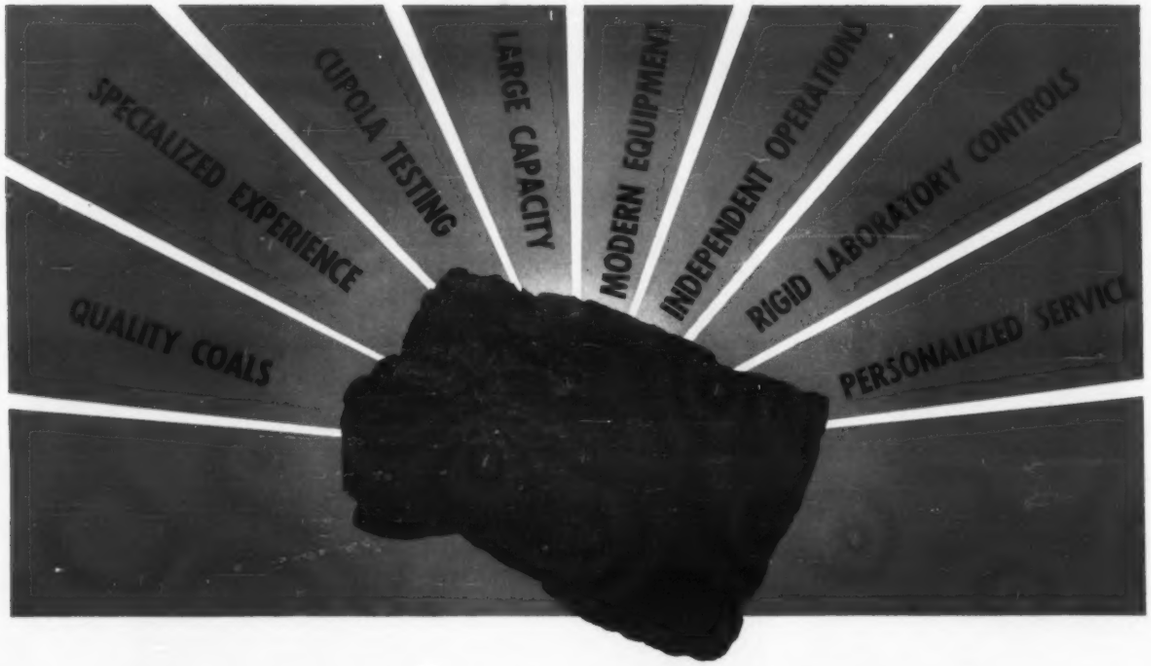
Already, cast turbine blades are the heart of the jet engine—pumping power into flight. Cast wave guides are the arteries of radar systems—carrying high frequency radio waves. Cast missile launcher bases are the arms that hold guided missiles in readiness.

Slow acceptance of castings stems from a kind of thinking criticized by "Boss" Kettering, General Motors Corp. director, in a recent radio interview. Kettering said—the trouble with most of us is that we are backing into the future while we gaze at the past. Design engineers and foundrymen must forget that castings were once considered low tensile, brittle, porous, metallic shapes and instead realize that castings are the shortest distance between raw material and finished product, with practically no limit to size, shape, cross section, surface finish, or dimensional accuracy.

A major step in stimulating this thinking came on July 12, 1955, when the Office of the Assistant Secretary of Defense instructed the National Academy of Sciences to "make a survey of the field of high-strength precision casting techniques, with particular emphasis on steel, to ascertain if there is promise of developing, through research, methods of producing castings which would be more widely usable in aircraft construction."

On April 20, 1956, the Academy culminated its urgent mission with a report to the Pentagon entitled "Precision Steel Castings for Aircraft Use." A few excerpts from this report follow. "Present activities are insufficient and uncoordinated . . . Further development must be done with full cooperation between aircraft builders and foundries . . . The government should sponsor and subsidize a broad program aimed at establishing the acceptability of steel castings for aircraft . . . The Department of Defense should make contracts with aircraft manufacturers for design and service testing of castings."

Results of these recommendations are evident in this issue of MODERN CASTINGS. But the castings industry only has its foot in the doorway to the future. Foundrymen must see to it that aircraft and missile men gain a new confidence in castings' ability to meet the challenge of top engineering standards. The opportunity is here and the time is now.



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German Foundries Harden Molds Without CO_2 Gas

■ Hardening of sodium silicate bonded molds without CO_2 gassing is being currently practiced in German foundries. The sand mixtures and advantages of this process are described in "Use of Waterglass-Molding Sand Mixes Without CO_2 Hardening for Gray Iron and Steel Casting," by A. Gebauer and O. Gerstmann, *Giessereitechnik*, No. 4, 1957.

Described in this paper are molding sand mixtures containing waterglass but carbon dioxide is not used to aid setting. The advantage is that the pattern can be removed from the still plastic mold when the molding sand has a good green strength. The danger of tearing off edges and corners is thereby greatly reduced. There is no need for excessive draft on the pattern and mold pins can be eliminated. Before pouring, the finished molds, especially those for large castings, must stand several hours after being made. But thin-walled castings (about 13/64-in. wall) can be cast in most cases after only a half-hours time elapse. This method has given good results at a Leipzig electric steel foundry.

Besides treatment with CO_2 gas waterglass-bonded molding sand can be hardened by drying either in the air or in stoves, or with a hot blast. The strengths thus attained are, for the same mixtures, almost always higher than those attained by gassing. If clay and bituminous coal dust, strongly water absorptive materials, are added to the mix, the plasticity of the molding sand is raised and setting is improved.

The time of mulling should be kept as short as possible, to prevent drying in the muller; but mixing must be thorough. The dry components are well mulled for 1-2 minutes and the process continued 2-3 minutes after addition of waterglass. After discharge from the muller the mixture is put into a container which is as airtight as possible.

Mixtures for the casting of gray iron should contain new silica sand, used sand, clay, bituminous-coal dust, and waterglass. Practically any reclaimed sand can be used to make the silica sand go further, provided it does not contain too much fines.

Bonding clays and bentonites at present common in foundries are satisfactory. A silica sand containing 0.3-0.6 per cent moisture should be used and completely dry sand should be tempered to this content prior to addition of waterglass.

Satisfactory results in the casting of gray iron have been obtained with

the following mixture for medium sized castings:

Type of Casting	Percentages
Silica sand	52
Reclaimed sand	36
Clay	2
Coal dust	4
Waterglass 48-50° Be	6

It is usually advisable to sprinkle graphite well over the pattern or finished mold to get satisfactory surfaces. Small molds can be closed within 30-60 minutes and metal poured into them. Larger ones should be allowed to stand 12 hours, and extremely large ones, 24 hours.

For steel castings weighing up to 220 lb, patterns are faced with the mixture and the rest of the flask filled with backing sand. This technique can also be used for gray iron casting. Results have been good with a mixture of 60 per cent silica sand, 30 per cent reclaimed sand, 3 per cent bentonite, and 7 per cent waterglass, 48-50° Be.

The molds should be allowed to stand at least 3 and preferably 5-6 hours before casting.

These described waterglass-clay-bonded mixes have sufficient green strength to allow the patterns to be removed without prior hardening of the molds, in contrast to the carbon dioxide process. Hardening is spontaneous and due to drying out of the waterglass. The strengths reached are sufficient for satisfactory casting of gray iron and steel.

More details of this process are contained in the complete translation of this article, No. 4008, for sale by Henry Brutcher, Box 157, Altadena, Calif.

Indian Symposium Aims at Industrial Modernization

■ "Recent Developments in Foundry Technology" will be the subject of a symposium to be held by the National Metallurgical Laboratory, at the United Club Auditorium, Jamshedpur, India, Feb. 5-8.

Distinguished technologists and scientists from India and other countries are expected to attend the symposium. Attention will be focused on the need for establishment of modern light and heavy foundry plants in India in order to achieve that country's industrial expansion as outlined in the government's second five year plan.

Director B. R. Nijhawan announced that new products and developments in technology from all parts of the world will be discussed at the symposium.

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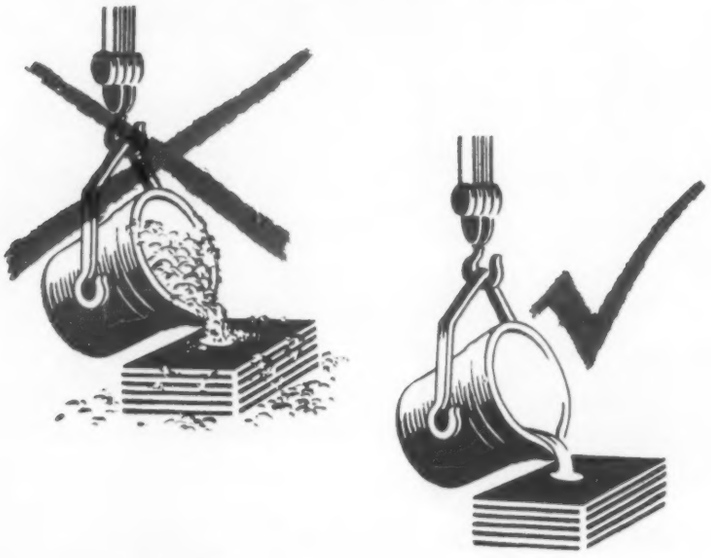

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Circle No. 126, Page 7-8

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products and processes

RUBBER CRASH DOORS . . . speeds transportation of material by eliminating stopping to open and close doors. Heavy rubber sheet opens with impact of truck, and closes automatically. Doors said to wear well and conserve heat and conditioned air. *Natural Rubber Bureau.*

For Manufacturer's Information Circle No. 1, Page 7-8

PORTABLE DRAFTING MACHINE . . . can be folded jackknife-style to fit in pocket. Made of aluminum, is said to take the place of T-square,

ruler, protractor, and triangles when attached to portable drawing board. *David Miller & Associates.*

For Manufacturer's Information Circle No. 2, Page 7-8

WETTING AGENTS . . . use fast action to provide effective means of reducing dust in foundry shakeout and sand handling systems. Normal water forms droplets when put on a dusty surface, water differs through its soaking of the entire surface. *Aquadyne Corp.*

For Manufacturer's Information Circle No. 3, Page 7-8

HIGH-SPEED MOISTURE ANALYZER . . . operating on principle of nuclear magnetic resonance, makes quantitative determinations of moisture content on wide variety of solids including clay. Analysis made in 30 sec to 4 min. Unit utilizes 40 cc sample size. *Shlumberger Well Surveying Corp.*

For Manufacturer's Information Circle No. 4, Page 7-8

WEAR RESISTANT . . . material said to have been tested to outwear steel 60 to 1. Becomes syrupy with addition of hardener, and can be cast without heat or pressure. Resists acids, alkalies, and solvents, and is self lubricating. Useful for building up surfaces subject to wear. *Devcon Corp.*

For Manufacturer's Information Circle No. 5, Page 7-8

PLASTIC EYESHIELDS . . . use nickel-plated ventilating screen to keep lens free of fog. Angle of lens and width of frame said to allow

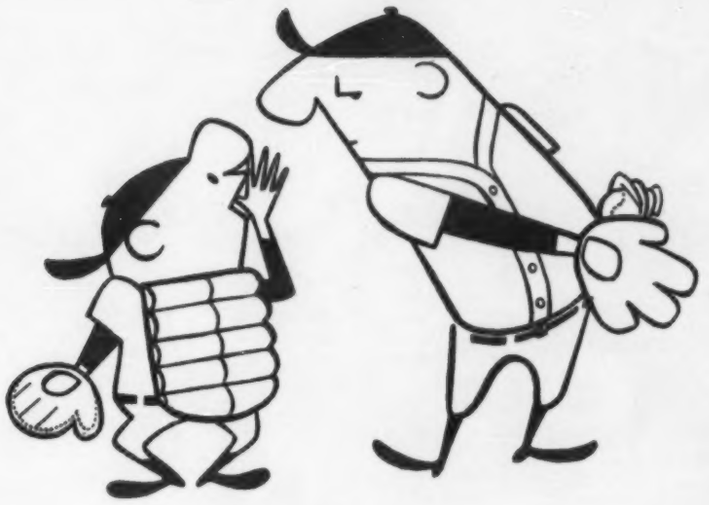
greater sideways and downward vision than ordinary eyeshields. Designed for comfortable use when worn over prescription glasses. *United States Safety Service Co.*

For Manufacturer's Information Circle No. 6, Page 7-8

AUTOMATIC DIE CASTING . . . machine said to improve quality and finish of castings over manually operated machines. Automatic operations include machine cycling, die cleaning and lubricating, inspection, water control, replenishing molten metal, and castings removal. Production rates exceeding 1500 shots per hour claimed by manufacturer. *British Industries Corp.*

For Manufacturer's Information Circle No. 7, Page 7-8

HORIZONTAL-GRATE COOLER... designed to provide uniform cooling for materials ranging in size from foundry sand to clinkers and pellets. Combination of stationary and movable grates tumbles the material to expose all sides to a constant flow of air forced both vertically and horizont-



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on all developments in metalcasting
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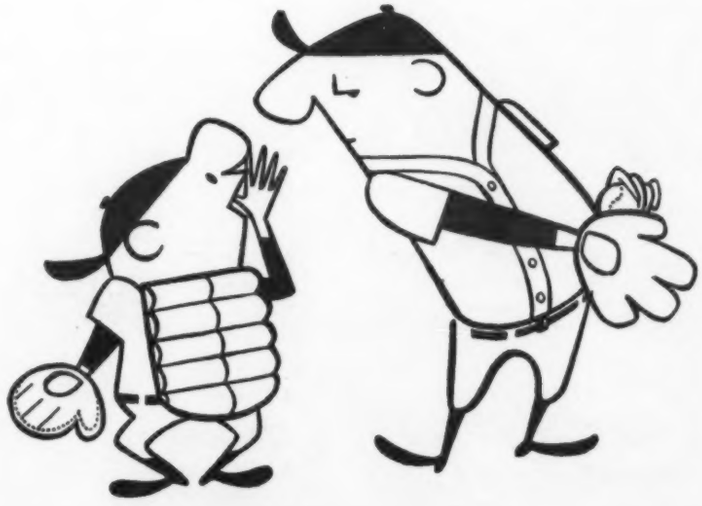

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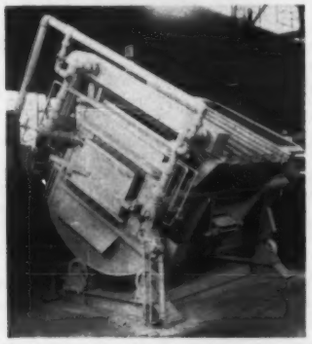
specified in feature
and special articles.

■ Details on these products and processes are available to MODERN CASTINGS readers. See pages 7-8.

ally through the grate. Speed of grate varied automatically to maintain uniform thickness and resistance to air. *Fuller Co.*

For Manufacturer's Information Circle No. 8, Page 7-8

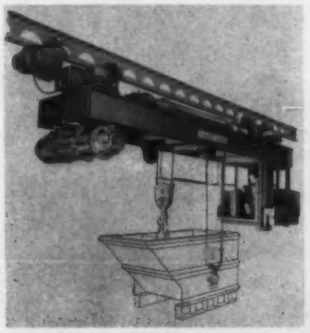
REVERBERATORY FURNACE . . . designed to provide hot metal continuously to holding furnaces for use in die casting, permanent molding, and sand casting. Furnace said to be easily charged, fluxed, alloyed, and



cleaned. Hot metal available from cold start in one to one and one-half hours, depending on size. Furnaces made in 1000, 1700, 2500, and 3000 lb holding capacities. *Stroman Furnace & Engineering Co.*

For Manufacturer's Information Circle No. 9, Page 7-8

HOIST CARRIER . . . picks up tote boxes, hauls them, and dumps them by tipping. Useful for handling castings, and sand. All motions controlled



by cab operator. Hoist speed, 35 ft per min; travel speed, 250. *Cleveland Crane & Engineering Co.*

For Manufacturer's Information Circle No. 10, Page 7-8

ULTRASONIC TESTING . . . thickness of sound conductive material measured by touching instrument to surface. Used to determine eccentricity in cored castings, pipe, etc.

BETTER, HARDER CORES...
BETTER, STRONGER MOLDS...
for close-tolerance castings

DELTA SILICATE BINDERS

Delta Silicate Core and Mold Binders can be hardened by gassing with CO_2, warm air, nitrogen and other gaseous vapors and also by oven drying.

FOR CORES—

285XX	Good shake out with low retained hot strength
299XX	Excellent shake out with very low retained hot strength

FOR MOLDS—

270XX	Fair shake out with high retained hot strength
292XX	Poor shake out with maximum retained hot strength

When used as recommended, sands prepared with Delta Silicate Binders have excellent bench life and other unusual properties which are "exclusively Delta". When "set", molds and cores have the necessary strength to insure a high production rate.

If improved flowability and release properties are necessary with the use of any type of silicate binder, Delta Sand Conditioning Oil or Delta No. 298 Release Agent is recommended.

DELTA

Get the facts... Working samples and complete literature on Delta Silicate Binders will be sent to you on request for test purposes in your own foundry.

DELTA OIL PRODUCTS CO.
MANUFACTURERS OF SCIENTIFICALLY CONTROLLED FOUNDRY PRODUCTS

MILWAUKEE 9, WISCONSIN

Circle No. 127, Page 7-8

"... gets larger loads quicker ... faster delivery with less spillage"

HYDRAULIC LOAD SHOCK-ABSORBER

Exclusive standard "PAYLOADER" feature — cushions the loaded bucket during travel, reduces jounce and bounce, slashes spillage losses, permits faster, safe carrying speeds.

Earl S. Ensign of Ensign Foundry Company, Toledo, says "this torque-converter model HA 'PAYLOADER' has better traction therefore loads quicker plus faster delivery with less spillage. It is also much easier on the operator which insures a more efficient operation with less abuse to the machine."

This 55-year old cast iron job foundry uses the new-style model HA for many jobs but mainly for handling new and old sand between bins, mixers, shakeouts, perforators, slingers and molding stations. With a payload capacity of 18 cu. ft. this "PAYLOADER" has the largest capacity of any tractor-shovel in its size range.

If you have an older model HA or any other tractor-shovel anywhere near its size it will pay you to find out how much more the new style HA can produce. Your Hough Distributor would like to show you. Contact him today, and ask about Hough Purchase and Lease Plans too.

THE FRANK G. HOUGH CO.
711 Sunnyside Ave., Libertyville, Ill.
Send more "PAYLOADER" information on:
☐ Model HA (2,000 lb. carry capacity)
☐ Larger models (up to 9,000 lb. carry capacity)
NAME_____
TITLE_____
COMPANY_____
STREET_____
CITY_____ STATE_____
1-A-2

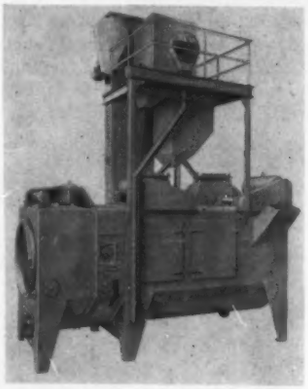
SAY "HUFF"

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

Unit operates on battery power; has ±2 per cent accuracy. *Magnaflux Corp.*

For Manufacturer's Information Circle No. 11, Page 7-8

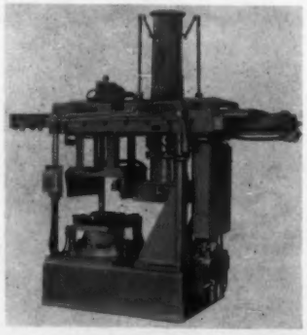
CONTINUOUS BLAST CLEANING . . . automatic machine designed to speed cleaning of continuous flow of castings. Material travels into cleaning chamber beneath two blast-



ing wheels, from there to discharge drum, and then into tote box or onto conveyor. Combination of tumbling and longitudinal travel exposes all surfaces to abrasive blast. Full length conveyor said to eliminate possibility of castings or abrasives jamming. *Wheelabrator Corp.*

For Manufacturer's Information Circle No. 12, Page 7-8

MOLDING MACHINE . . . said to provide accurate control of mold density and casting finish. Operator only handles empty flasks. Fixed volume



of sand is blown into preformed cavity and squeezed into flask automatically. Pattern then stripped from mold. *Osborn Mfg. Co.*

For Manufacturer's Information Circle No. 13, Page 7-8

IRON-CHROMIUM-ALUMINUM . . . new resistance-heating alloy uses no critical raw materials and has greater ductility than other alloys of similar

Circle No. 129, Page 7-8

■ Details on these products and processes are available to MODERN CASTINGS readers. See pages 7-8.

type. Numerous foundry applications for developing temperatures up to 2150 F. *Hoskins Mfg. Co.*

For Manufacturer's Information Circle No. 14, Page 7-8

TRAVELING CRANE . . . for use both inside and outside of building, opens foundry doors automatically. Door is pushed to end of runway, anchored for as long as necessary, then returned to its proper position. *All-State Engineering Co.*

For Manufacturer's Information Circle No. 15, Page 7-8

HEAVY DUTY CONTAINER . . . designed to handle heavy castings. Use of heavy wire mesh affords visual inventory. Features runners to allow sliding without damage to legs. Dimensions are 48x53x38 in.; 6000 lb capacity claimed. *Tri-State Engineering Co.*

For Manufacturer's Information Circle No. 16, Page 7-8

ALUMINUM INGOTS . . . produced in T-shape to facilitate unloading, handling, storage, and melting. Designed to fit on tines of fork lift trucks. Ingots can be handled either individually or in stacks without strapping. *Aluminum Limited Sales, Inc.*

For Manufacturer's Information Circle No. 17, Page 7-8

BRICK TOOL . . . said to cut furnace rebuilding time by 80 per cent. The manually operated portable masonry splitter handles end, angle and miter cutting operations. Claims elimination of flying dust and fragments. *E. & R. Mfg. Co.*

For Manufacturer's Information Circle No. 18, Page 7-8

FLUID TRANSFER PUMP . . . for 55-gal drums, air-powered, automatically stops as operator releases trigger. Operates either in open head or 2-in. bung opening. May be used for transferring, mixing, or measuring fluids used in foundry or pattern shop. *Gray Co.*

For Manufacturer's Information Circle No. 19, Page 7-8

CORROSIVE FLUID PUMP . . . utilizes diaphragm and piston to give smooth flow. Pump is useful in controlling flow, liquid level, pH, and temperature. All surfaces which are to contact corrosives are composed of solid fluro-carbons, making the surfaces resistant to chemicals. *Keystone Engineering Co.*

For Manufacturer's Information Circle No. 20, Page 7-8

Circle No. 130, Page 7-8

ADCOSIL

BEST FOR CO_2 CORES...

An exclusive feature in ADCOSIL is a color indicator that tells when to stop gassing a CO_2 core. The core mix is tinted a royal purple . . . then fades to a natural sand color when the core is cured throughout.

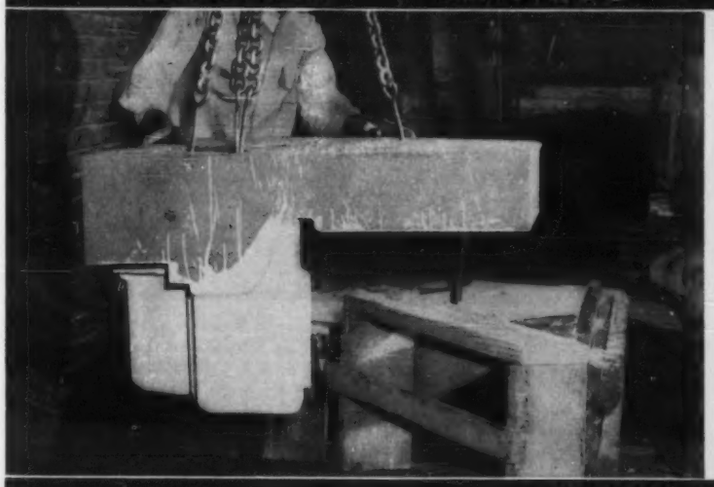
ADCOSIL helps determine where to place core vents and how many to use; helps rig new boxes and patterns; prevents under-gassing, over-gassing; encourages cores designed for most efficient flow of gas; cuts time and costs; saves gas.

Flowability, workability, core hardness, and long bench life are inherent in ADCOSIL sand mixtures.

Several types are available:

For ferrous metals . . . . . ADCOSIL F
For non-ferrous metals . . . . . ADCOSIL NF
For super-collapsibility, all metals. ADCOSIL SC

ARCHER • DANIELS • MIDLAND COMPANY



LIN-O-SET

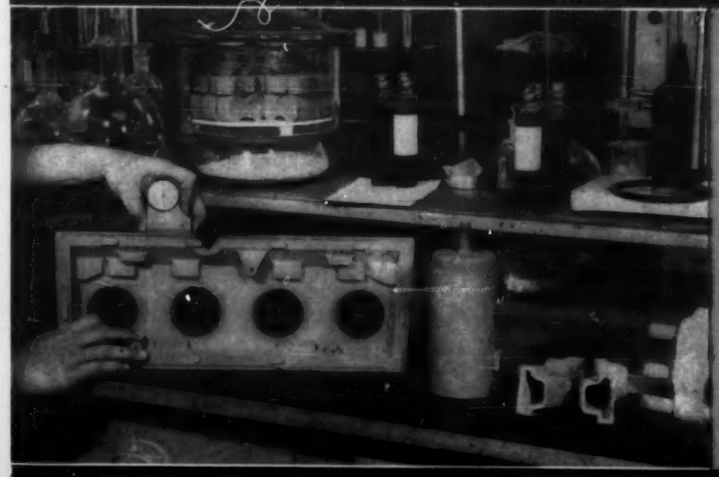
BEST FOR AIR SET CORES...

Original LIN-O-SET, introduced by ADM and praised by large jobbing foundries coast-to-coast, is scarcely a year old. Still, a newer and more phenomenal air-setting binder, LIN-O-SET II, is already available to foundries searching for maximum efficiency.

LIN-O-SET II works in room temperature at exceptional speed hardening the "core of the core" almost as fast as the exposed surfaces. An ADM "first", this development takes the guesswork out of drawing, since the curing of a LIN-O-SET II core combines internal polymerization with surface oxidation.

All this . . . plus the better-known LIN-O-SET features; minimum ramming; saving in cleaning time; thorough collapsibility; elimination of excessive rodding; control of set-up time; improved accuracy; elimination of objectionable odors and toxic gases.

FEDERAL FOUNDRY SUPPLY DIVISION



ADMIREZ

BEST FOR SHELL-MOLDS AND SHELL-CORES...

ADMIREZ CC-240, newly developed in ADM's Resin Research Laboratory, utilizes a cold coating process. It is a dry powdered product containing a cure catalyst which promotes rapid transformation of the resin from a low-melting-point, alcohol-soluble material to a hard, infusible solid under the influence of heated air.

Two basic improvements are offered by ADMIREZ CC-240 over earlier resins: elimination of sand-resin segregation; reduction of economically prohibitive high resin requirements. Advantages are: fast coating; quick breakdown during mulling; high flowability of coated sand; exceptionally fast cure time; excellent stripping from pattern; high tensile strength and lack of brittleness; low-shell breakage; lack of thermal plasticity.

2191 WEST 110TH STREET • CLEVELAND 2, OHIO

Now included in the Archer Quality Line...

SAN-BLO CORE BLOWER . . . WHEELMIX SAND MIXERS
FEDERAL GREEN BOND BENTONITE . . . FEDERAL SAND STABILIZER
CROWN HILL SEA COAL . . . and a COMPLETE LINE of FOUNDRY FACINGS

Gentlemen, I am interested in trying: Check One

ADMIREZ CC-240 . ☐
LIN-O-SET II . . . . ☐
ADCOSIL F . . . . ☐
ADCOSIL NF . . . . ☐
ADCOSIL SC . . . . ☐

ARCHER-DANIELS-MIDLAND COMPANY
Federal Foundry Supply Div.
2191 West 110th Street
Cleveland 2, Ohio

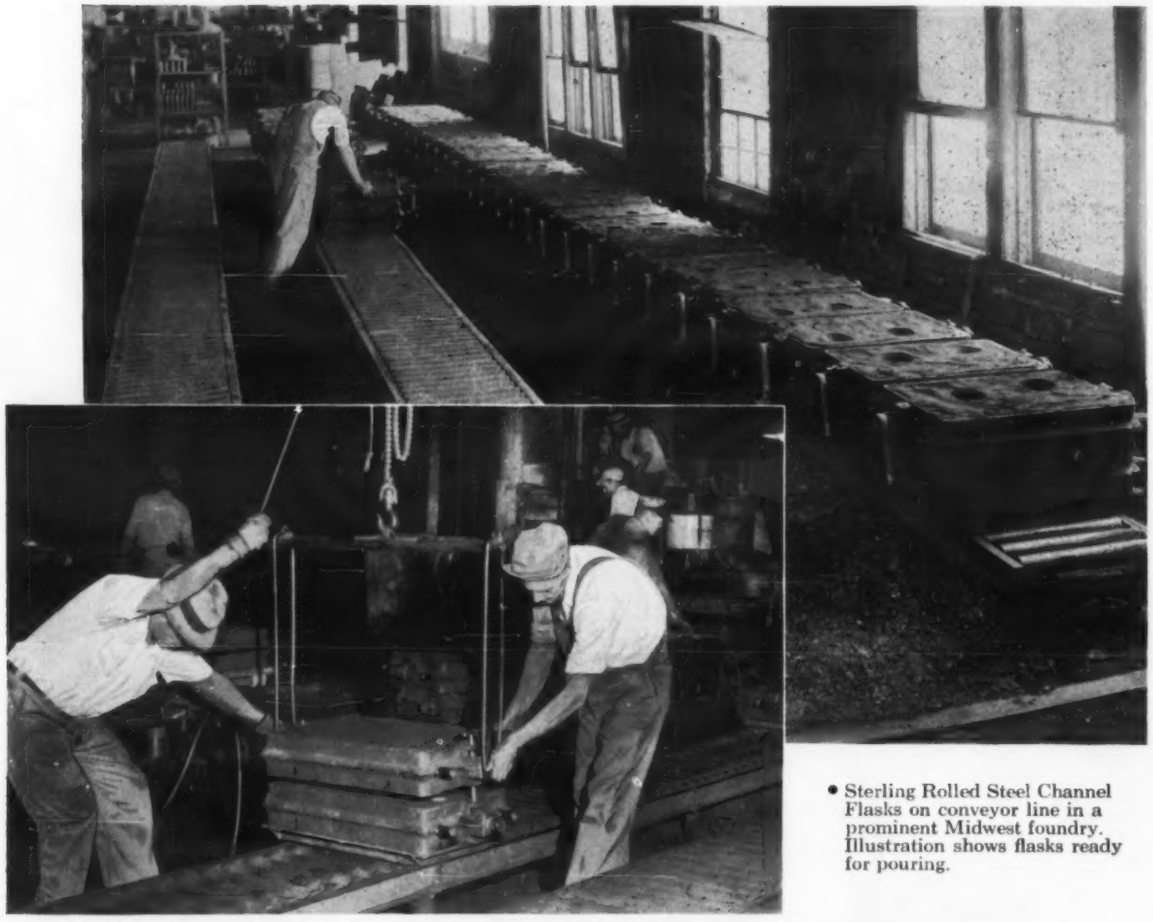
Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____



• Sterling Rolled Steel Channel Flasks on conveyor line in a prominent Midwest foundry. Illustration shows flasks ready for pouring.

COPPER BEARING

...adds years to flask life!

Do your fabricated steel foundry flasks have controlled copper bearing? All Sterling Special Rolled Steel Channel Flasks do. In fact, Sterlings have considerably more copper bearing than you normally find in steel as it comes from the mills.

What does copper bearing mean to smart foundrymen? Plenty! It means many more years of flask life because of reduced corrosion. It cuts down the cost of flasks per year. That's why Sterling Flasks are preferred by foundrymen all over the world.

If you have a flask problem, consult Sterling. Write today for your copy of the new Sterling Catalog.

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LONDON • BEDFORD • JARROW-on-TYNE, England

Manufacturers of Foundry Equipment for Almost a Half Century!

Circle No. 131, Page 7-8

ELECTRIC LOAD CELLS . . . measure by elastic deflection, provide remote indication or continuous reading of weight. Used to control loading equipment or in processes which feed materials handling equipment.

Useful where measuring is affected by impact and vibration, fine abrasive dust; adverse ambient conditions, awkward structures, or where equipment must be portable. *Leeds & Northrop Co.*

For Manufacturer's Information
Circle No. 21, Page 7-8

SPACE HEATER CONTROL . . . has automatic safety device which shuts off gas to main burner and pilot in case of pilot outage. Stop prevents accidential pilot shut off. *Robertshaw-Fulton Controls Co.*

For Manufacturer's Information
Circle No. 22, Page 7-8

APPRAISOR . . . circular slide rule eliminates mathematical formulae in analyzing new equipment proposals. Useful in determining whether new equipment will pay. *Van D. Mark.*

For Manufacturer's Information
Circle No. 23, Page 7-8

NODULAR IRON . . . produced with lance injector which adds small amounts of powdered magnesium to melt through nitrogen stream. Lance is said to make possible low-sulphur iron from a poor-quality, cheap charge. *Engineering Imports.*

For Manufacturer's Information
Circle No. 24, Page 7-8

VACUUM ANNEALING FURNACE . . . for light production, converts to a melting furnace, providing one installation for vacuum processing. Capable of operating continuously at 2150 F or intermittently at 2200 F. *High Vacuum Equipment Corp.*

For Manufacturer's Information
Circle No. 25, Page 7-8

SPECTROMETER . . . permits analysis of C, P, and S simultaneously with Si, Mn, and other metallics in steel and cast iron. Designed for direct-reading analysis in the region 1600 to 3300A. *Applied Research Laboratories.*

For Manufacturer's Information
Circle No. 26, Page 7-8

TROLLEY CONVEYOR SYSTEM . . . for light-duty, overhead conveying. Lightweight track is installed with standardized parts. Grease-packed wheel made specifically for this conveyor. Sprocket drive unit capacities from 350 to 750 lbs. *Mathews Conveyor Co.*

For Manufacturer's Information
Circle No. 27, Page 7-8

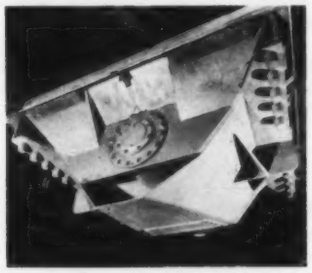
CHROMIUM DIFFUSION PROCESS . . . increases heat, wear and corrosion resistance of iron and steel castings. Surface hardness said to be

■ Details on these products and processes are available to MODERN CASTINGS readers. See pages 7-8.

higher than can be created by any conventional hardening method. Service life of pump pistons was increased three times. *Chromalloy Corp.*

For Manufacturer's Information
Circle No. 28, Page 7-8

SIDE DISCHARGE SHAKEOUT . . . permits discharge of sand to side of machine. Useful in foundries which



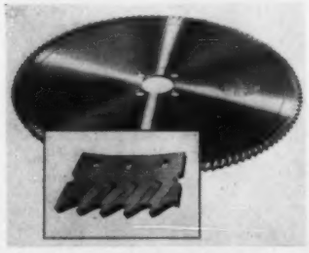
cannot locate conveyor immediately below shakeout. *Allis Chalmers Mfg. Co.*

For Manufacturer's Information
Circle No. 29, Page 7-8

SELF LOCKING CLAMP . . . has cam trigger that locks in place in five positions to speed sawing, filing, nailing, and gluing. Rubber jaws prevent marring. *Wedgelock Corp.*

For Manufacturer's Information
Circle No. 30, Page 7-8

COLD CUTTING SAWS . . . have alternating roughing and finishing teeth. Roughing teeth remove center of cut; finishing teeth, outer corners.



Load is reduced on each tooth, reduction friction. Said to assist flow of lubricant to cutting edges, assisting in cooling. *Ernest F. Donley's Sons, Inc.*

For Manufacturer's Information
Circle No. 31, Page 7-8

BLUE-PRINT CLAMP . . . said to hold sheets in place even if fully loaded up to the final page. No tools or fasteners required. *Plan Hold Corp.*

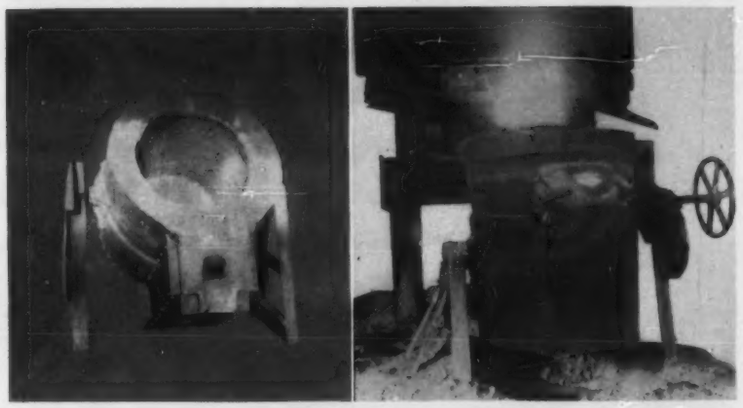
For Manufacturer's Information
Circle No. 32, Page 7-8

EPOXY RESIN . . . and hardener automatically measured in correct

VOLCLAY BENTONITE
NEWS LETTER NO. 54

REPORTING NEWS AND DEVELOPMENTS IN THE FOUNDRY USE OF BENTONITE

pinholes or inclusions ?



Left: Teapot reservoir ladle with ganister lining. Right: Same ladle in use with cover in place.

Courtesy AFS "Handbook of Cupola Operations" 1946

Inspect that pinhole!

Pinholes may be judged incorrectly. Inclusions may cause as many pinholes as entrapped gas.

Inclusions are not dirt! If the inclusion is slag, sand, refractory, manganese sulphide, dross or others, it must be named, **not called "dirt!" The word "dirt" must leave foundry nomenclature.**

Many pinholes occur from inclusions. Poor melting and ladle practice can create such defects.

A ladle not properly cleaned after a heat may contribute to pinhole inclusions.

Turbulence in a ladle which has been poorly rammed, or contains poor refractory material provokes inclusions. Good ladle practice is essential.

Ladles not properly heated may be a direct cause for cold metal which in turn is conducive to inclusions.

It is dangerous to patch a ladle or spout during pouring as this most often contributes to inclusions.

Poorly prepared metal may result in oxidized and sluggish metal. Non-metallic inclusions adhere more readily in such metal. Surface oxides on the metal must be trapped or skimmed, otherwise scrap will result. Melting furnace refractories erode easily under thermal chemical activity, temperature, pressure, or abrasion.

Careless skimming and pouring is a common cause of inclusions.

Interrupted pouring or irregular pouring encourages contamination in the mold.

Sand is responsible for its share of inclusions but cannot accept the full blame!

WRITE FOR BULLETIN: AF-14 . . . "IT'S NOT ALL SAND!"

AMERICAN COLLOID COMPANY

Chicago 54, Illinois • Producers of Volclay and Panther Creek Bentonite

Circle No. 132, Page 7-8

Call the waterboy, Princess Wenatchee! Chief Keokuk opened his book on making a hard, clean tackle . . . but it looks like first string Junior cut this lesson short!

Are those rough characters "Punk" Quality and "Bulgy" Costs running right over you? Tackle them now! Blow the whistle and send in triple-threat Keokuk Silvery Pig Iron to hold that line . . . it's used by leading foundries and steel plants. Pig for pig . . . car for car, its uniformity never varies. Handle by magnet, charge by weight or count the pigs for equal accuracy. Aluminum producers . . . you'll score every time with Keokuk Silicon Metal!

KEOKUK ELECTRO-METALS COMPANY
Keokuk, Iowa
Wenatchee Division, Wenatchee, Washington

KEOKUK SILVERY PIG IRON
SILICON METAL—OTHER FERROALLOYS

Keokuk Silvery Pig is available in 60 and 30 lb. pigs and 12½ lb. piglets in standard analysis or alloyed to your specifications. Silicon metal and ferro-silicon are supplied in standard sizes and analyses.

SALES AGENT: MILLER AND COMPANY
332 S. Michigan Ave., Chicago 4, Illinois
3504 Carew Tower, Cincinnati 2, Ohio
8230 Forsyth Blvd., St. Louis 24, Missouri

Circle No. 133, Page 7-8

proportion. Resin and hardener packaged in separate tubes, each depositing correct volume on surface to be repaired or joined when squeezed in equal lengths according to manufacture. *Smooth-On Mfg. Co.*

For Manufacturer's Information Circle No. 33, Page 7-8

CONVEYOR OILER . . . applies oil automatically to chain links and pins of all chain-type conveyors by contact of felt rollers. Even film of oil said to be applied without mist, spray, or drip, despite normal sway of chain in motion. *Olsen Mfg. Co.*

For Manufacturer's Information Circle No. 34, Page 7-8

REVERSIBLE GLOVE . . . has two thumbs which give the glove two palms. Said to offer extra cushioning,

protection against rough material, and insulation against heat, plus longer wear. *David's Gloves, Inc.*

For Manufacturer's Information Circle No. 35, Page 7-8

LAB FURNACE . . . for low cost testing of small samples at temperatures up to 2650 F. Fired by gas

and air, furnace chambered for crucibles to 15/16 in. base diameter by 2¼ in. high. *Selas Corp. of America.*

For Manufacturer's Information Circle No. 36, Page 7-8

POWER SHIFT . . . lift truck with torque converter drive said to operate with new ease, economy, and safety. Finger-tip touch changes gears with left hand leaving right hand free to operate tilt, lift, and attachment controls. Has combination brake and inching pedal, plus independent brake. Shifts to neutral when driver leaves seat. *Allis-Chalmers Mfg. Co.*

For Manufacturer's Information Circle No. 37, Page 7-8

LIGHTWEIGHT WINCH . . . with rated capacity up to 6000 lb. Reel-

■ **Details on these products and processes are available to MODERN CASTINGS readers. See pages 7-8.**

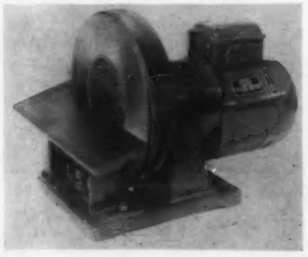
in rate is 10 ft per min at 6000 lb and 20 ft per min at 3000 lb. The unit weighs 35 lb. Constructed to permit flange, base, or suspension mounting for versatile operation. *All American Engineering Co.*

For Manufacturer's Information Circle No. 38, Page 7-8

ATMOSPHERE ELECTRIC FURNACE . . . for heat treating steel. Generator utilizes alcohol as one of possible atmosphere generating liquids. Atmosphere is said to be useful for clean hardening, carburizing, and preventing decarburization of straight or chrome nickel steels. *L. L. Mfg. Co.*

For Manufacturer's Information Circle No. 39, Page 7-8

ROTARY FILING . . . tool with cutting teeth which mechanize operations of filing, shaping, and milling. Manufacturer claims unit speeds hand tooled operations 3 to 10 times.



Adaptable for materials which cannot be worked on an abrasive wheel. Filing unit is available with rings of consistencies fine, medium, and coarse. *Hudson Automatic Machine & Tool Co.*

For Manufacturer's Information Circle No. 40, Page 7-8

SHELL MOLD . . . release agent eliminates sticking, break-in, build-up, and cleaning of shell mold patterns and core boxes. Applied by spray or brush, coating tested to withstand temperatures over 1000 F. Smokeless, non-toxic, and inert, this material also is said to be an effective high temperature lubricant. *Chem-Cote Co.*

For Manufacturer's Information Circle No. 41, Page 7-8

DIRECT READING CALIPER . . . saves time in measuring parts and materials. Measures irregular castings up to four in. thick. Size is read directly on scale calibrated in 32nds of an in. Readings three in. from edge of work possible. *Master Specialty Co., Inc.*

For Manufacturer's Information Circle No. 42, Page 7-8

FOUNDREZ 7500 is a very finely powdered thermosetting phenolic resin. You will find that it blends easily, gives uniform shell mold structure and strength in economical sand-to-resin ratios.

When you produce shell molds with FOUNDREZ 7500, you reduce curing cycles. This remarkable RCI resin performs satisfactorily at extremely high oven temperatures, lets you turn out more molds per hour.

While FOUNDREZ 7500 works well in almost all applications, it is especially recommended for tough and intricate jobs where the patterns have a deep draw, and where the sand must flow, fill and bake extra well.

FOUNDREZ 7504 is very similar to FOUNDREZ 7500 but is faster setting and intended for use in high speed production. It generally gives a more rigid shell mold than FOUNDREZ 7500.

For large and small parts cast with any ferrous or non-ferrous material, shell molding with FOUNDREZ 7500 and 7504 is ideal . . . particularly for long production runs. For technical help or complete information, write to RCI Foundry Division in White Plains.

Creative Chemistry . . .
Your Partner in Progress

RCI

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives • Plasticizers
Phenol • Formaldehyde • Glycerine • Phthalic Anhydride • Maleic Anhydride
Sodium Sulfite • Pentaerythritol • Pentachlorophenol • Sulfuric Acid

REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N. Y.

Circle No. 134, Page 7-8

First with—
BETTER METAL ABRASIVES FOR *Blast-Cleaning*

For 70 years Pittsburgh Crushed Steel Company has developed better metal abrasive through exhaustive research and has maintained its leadership by continuing research and improvement.

A complete line of steel malleable and standard chilled iron shot and grit.

NOW IN 50-LB. *Double Burlap* BAGS

Sold and Recommended by PANGBORN CORPORATION Hagerstown, Md.

- **Samson Shot and Angular Grit** — The original chilled iron metal abrasives that led to the conversion from sand to metal abrasives for blast cleaning. Still accepted today as the best.
- **Malleabrasive** — The original patented malleablized type of metal abrasive of greater toughness and longer life. Still leads the field.
- **Tru-Steel Shot** — The original super-tough, heat-treated and drawn shot of tool steel quality. Now the pace setter in production of the all-steel type of shot.

Packed in handy 50 pound reinforced burlap bags — easy to handle — speeds unloading of truck and handling within the plant.

PITTSBURGH CRUSHED STEEL CO.

Arsenal Station, Pittsburgh 1, Pa.

Subsidiaries: Globe Steel Abrasive Co., Mansfield, Ohio; Steel Shot Producers, Inc., Butler, Pa.

METAL ABRASIVES FOR EVERY NEED

Circle No. 135, Page 7-8

Build an idea file for plant improvements. Reader Service Cards, pages 7-8 will bring more information . . .

for the asking

Wall chart, to be used as a guide, lists 41 properties for 37 different stainless steels. Embraces purpose of formulation, simplified table of compositions, remarks on fabrication, representative mechanical properties, nominal properties, elevated temperature service, heat treating, physical properties. *Electro Metallurgical Co.*

Circle No. 61, Page 7-8

Aircraft castings superior to forgings and fabrications are described in extensive technical report. Profusely illustrated with "before" and "after" photos. *General Alloys Co.*

Circle No. 62, Page 7-8

Welding pocket-size data book encompasses 120 welding rods, electrodes, and welding compounds. Guide to brazing, soldering, torch welding and soldering, and preparation steps for all metals. *Eutectic Welding Alloys Corp.*

Circle No. 63, Page 7-8

Shell cores eliminate machining of large stainless castings. This 4-p reprint contains diagrams of shell core, mold, and finished part. Traces problems encountered and how they were overcome. *Cooper Alloy Corp.*

Circle No. 64, Page 7-8

Better die castings—revised pocket guide—contains a wealth of helpful data on factors which influence production of sound zinc-alloy die castings with a good surface finish. Covers alloy composition, standard specifications, temperatures, metal injection pressures, gating, venting, quenching, care of dies and machines, etc. *Henning Bros. & Smith, Inc.*

Circle No. 65, Page 7-8

Forsterite shell molding material for steel castings. Product and application bulletin will provide you with information on general practice now used by several steel foundries making castings on experimental or small production basis. Said to produce steel castings without imperfections found when made in silica-sand shells. *Harbison-Walker Refractories Co.*

Circle No. 66, Page 7-8

College-Industry Committee reprint on material handling education available. Explains functions and organizational structure of committee and how they aid colleges and universities in material handling courses. *The Material Handling Institute, Inc.*

Circle No. 67, Page 7-8

Conversion factor wall chart is ideal reference table for engineers, executives, to speed up location of factors used daily. Included are common conversions such as inches to centimeters, watts to H.P., cu ft. to liters, microns to meters and quintal to lbs. *Precision Equipment Co.*

Circle No. 68, Page 7-8

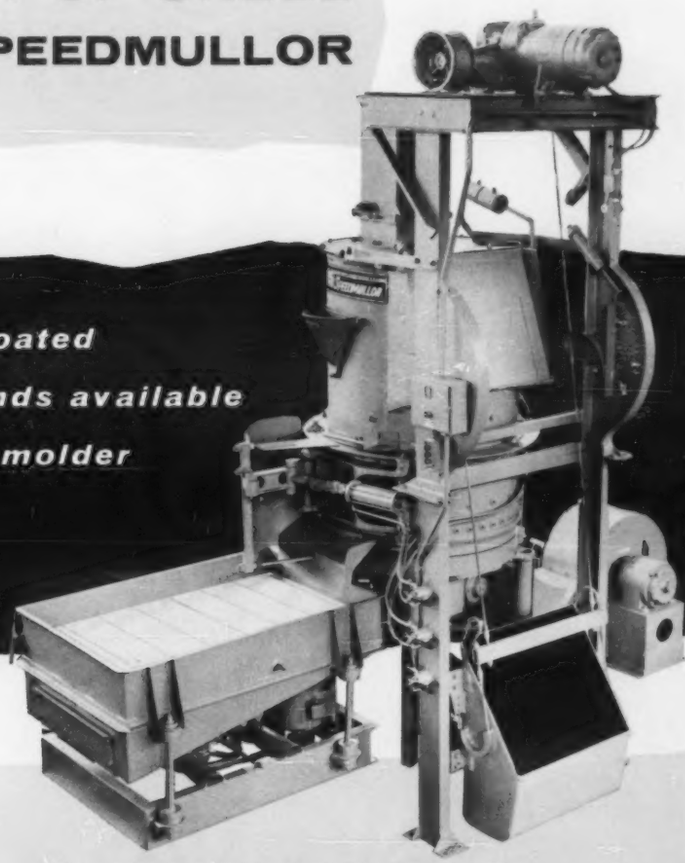
Investment castings booklet explains new process of precision investment casting in all castable ferrous and non-ferrous metals. Similar in accuracy and finish to lost wax casting but up to 1/2 ton and larger in size. Made from simple refractory molds utilizing low cost patterns and equipment. *Shaw Process Development Corp.*

Circle No. 69, Page 7-8

Metal grating handbook, said to be first all-inclusive technical publication to represent product standardization in metal grating industry. Contains

Circle No. 136, Page 7-8

THE NEW **CP SHELL SAND SPEEDMULLOR**



...makes resin-coated sands available to any shell molder

You can't afford to be without these advantages.

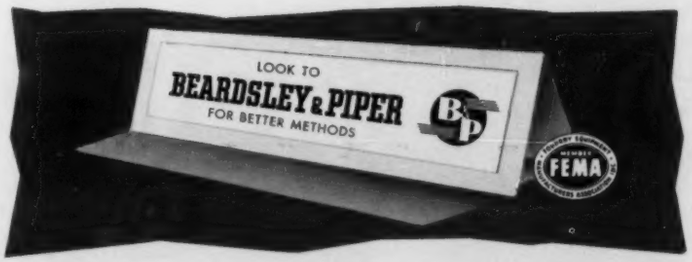
- ☆ Up to 50% saving in resin for equal strengths . . . maximum physical properties with resin contents of 3%.
- ☆ The cold process Shell Sand Speedmullor successfully coats any sand with any resin . . . maximum flexibility.
- ☆ Highest capacity per dollar of equipment expenditure or per square foot of floor area.
- ☆ Complete automatic control—Mulltrolmatic—insures uniformity . . . batch after batch and day after day.
- ☆ Cycle time is only a fraction of that required by any other equipment.
- ☆ Speedmullor coated sands solve all problems of resin segregation and completely eliminate the health and safety hazards of uncoated sands.

Send today for Bulletin No. 6000

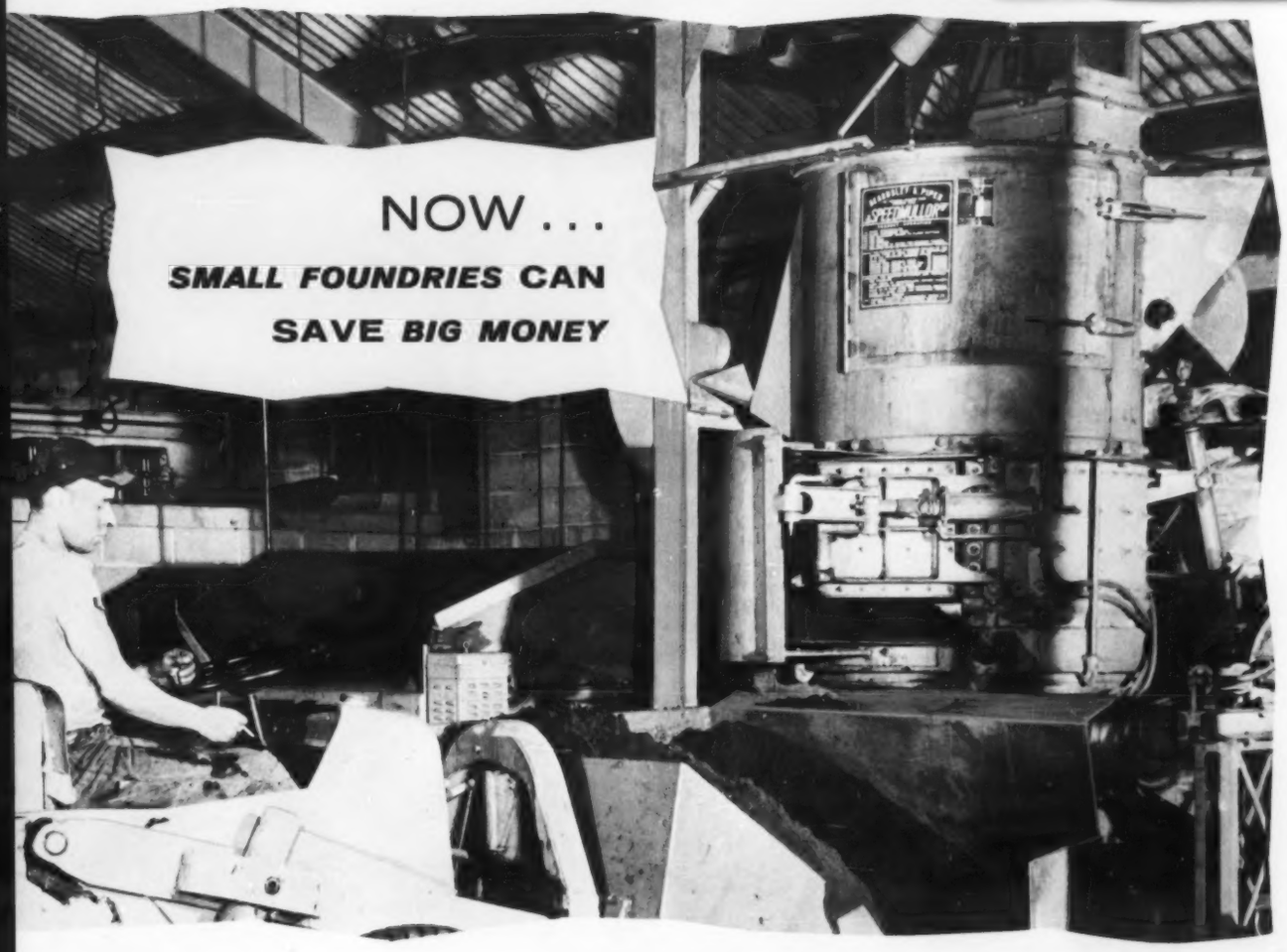
THE WORLD'S LARGEST

EXCLUSIVE MANUFACTURER

OF FOUNDRY MACHINERY



BEARDSLEY AND PIPER
DIV. PETTIBONE MULLIKEN CORP.
2424 N. Cicero Avenue, Chicago 39, Ill.



Fully mulled and conditioned sand with savings of $60 a day!

Now the advantages of fully controlled sand practice are available to really small foundries at a cost they can readily afford. This small iron shop has installed a Model '40-60' Speedmullor-Preparator Unit to fully prepare all of the sand for the foundry's nine molding floors.

The estimated saving is sixteen man hours a day on sand alone. Reduced cleaning time and lowered casting losses bring the total saving to 60 dollars a day. The first year's saving will more than pay the total cost of the entire unit including installation.

With machinery like this available, the small foundryman can't afford *not* to mechanize.

Bulletin No. 1230 will give full information.

B & P SPEEDMULLOR-PREPARATOR UNITS

BEARDSLEY AND PIPER
DIV. PETTIBONE MULLIKEN CORP.
2424 N. Cicero Avenue, Chicago 39, Ill.

32 pp. of informative text, schematic drawings, tables and actual installation photographs as well as complete standards and specifications. Also has glossary of terms and definitions. *Metal Grating Institute, Inc.*

Circle No. 70, Page 7-8

"Photography Through The Microscope" data book of elementary photomicrographic technique available in a revised edition. Brought up to date on current materials, equipment and practices including new specialized techniques of ultraviolet, infrared, phase and electron photomicrography. *Eastman Kodak Co.*

Circle No. 71, Page 7-8

Flame-plating process—a method of applying thin coating of tungsten carbide and aluminum oxide—outlined in 20-p catalog. Spindles, bushings, seals,

gages, mandrels, dies and core rods are only a few of the many current applications where this process is said to greatly improve wear resistance of castings. *Linde Air Products Co.*

Circle No. 72, Page 7-8

Temperature conversion chart, wallet-size, available with easy-to-read tables of Fahrenheit and Centigrade temperature equivalents — an invaluable time saver. Reverse side of 8-1/2 x 3-1/2 in. chart illustrates, by means of animated demonstration, easy reading qualities of thermometers made with Moeller Glass Red Reading Column. *Moeller Instrument Co.*

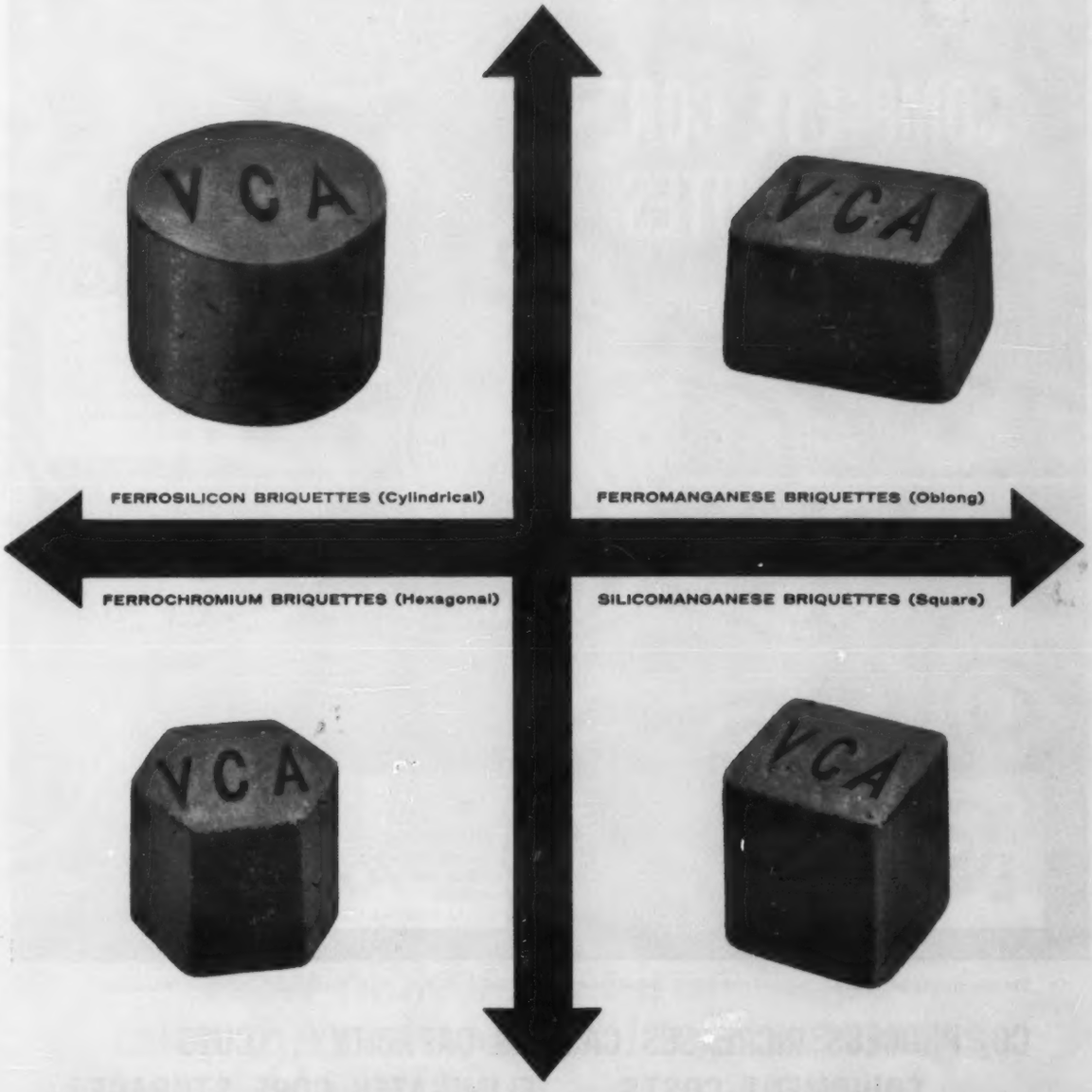
Circle No. 73, Page 7-8

Sling chain service program. Information-packed bulletin tells of manufacturer's unique localized sling-chain service program which solves problem of slow delivery. *American Chain & Cable Co.*

Circle No. 74, Page 7-8

Grinding wheels, vitrified and resinoid, are available in standard sizes

Circle No. 136, Page 7-8



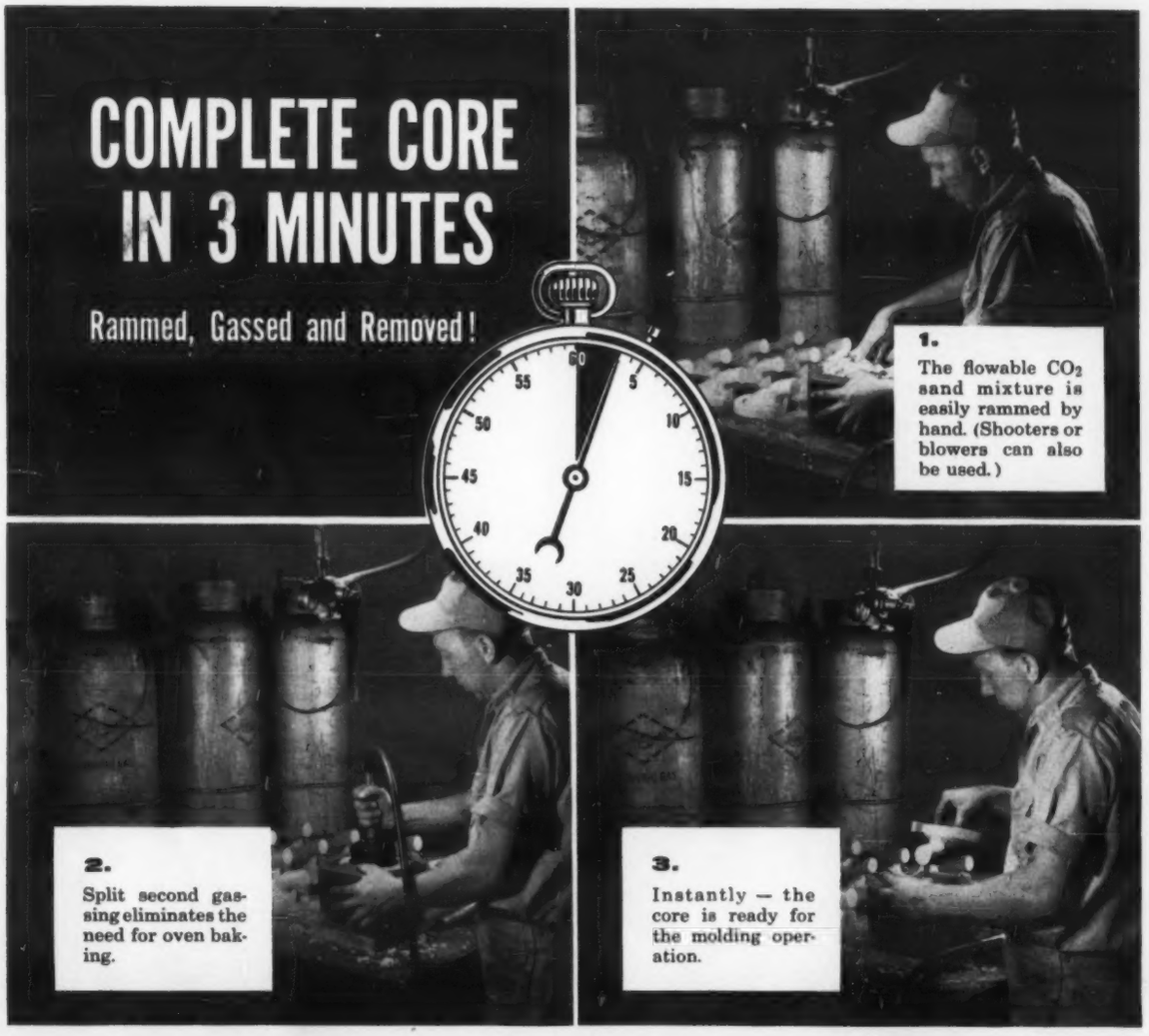
ANY WAY YOU LOOK AT IT, VCA *is headquarters for every major type of briquettes!* Briquettes are the easy way to avoid errors in alloy additions to cast irons. And to make alloy addition even *more* reliable, insist on Vancoram Briquettes! They set the standard for quality and uniformity of composition. Vancoram Briquettes are available in bulk, or in bags or pallet boxes for easy storing and handling. The VCA representative in your locality can tell you more about Vancoram Briquettes—or call these distributors of Vancoram products for the iron foundry:

PACIFIC METALS COMPANY, LTD. • STEEL SALES CORPORATION
J. M. TULL METAL AND SUPPLY CO., INC. • WHITEHEAD METAL PRODUCTS CO., INC. • WILLIAMS AND CO., INC.

VANADIUM CORPORATION OF AMERICA

420 Lexington Avenue, New York 17, N. Y. Chicago • Cleveland • Detroit • Pittsburgh

Circle No. 137, Page 7-8


COMPLETE CORE
IN 3 MINUTES
Rammed, Gassed and Removed!
1.
The flowable CO_2 sand mixture is easily rammed by hand. (Shooters or blowers can also be used.)
2.
Split second gassing eliminates the need for oven baking.
3.
Instantly — the core is ready for the molding operation.

The CO_2 process proves to be a fast and economical method for core production at the J. M. Bruce Foundry in Cedar Grove, Wisconsin.

CO_2 PROCESS INCREASES CASTING CAPACITY . . . CUTS EQUIPMENT COSTS . . . ELIMINATES CORE STORAGE!

Glen and Mark Bruce, who operate the 40 year-old J. M. Bruce Foundry Co., are enthusiastic about the use of CO_2. An actual cash savings of thousands of dollars is reported due to the decrease in baking equipment and core storage. Valuable floor space previously used for core storage is now allocated to actual production use.

For J. M. Bruce Foundry Co. the big advantages in CO_2 are the increased size of the castings they can pour (without buying special core equipment)—50% reductions in core costs . . . virtual elimination of "plows" . . . no danger of drops, soft or wet spots . . . reduced core handling, extreme speed and flexibility in supplying core needs, and *making cores only when they need 'em.*

Get the facts on CO_2 core and mold making—complete information sent upon request.

World's Largest Producer of
LIQUID CARBONIC
DIVISION OF GENERAL DYNAMICS CORPORATION
3166 South Kedzie Ave., Chicago 23, Illinois

Circle No. 138, Page 7-8

and shapes or can be engineered to meet specific application and materials requirements. Brochure of 16 pp shows basic steps in production and manufacture with detailed breakdown of ideal abrasives, bond and specification recommended for different types of metals. *Simonds Worden White Co.*

Circle No. 75, Page 7-8

Radiography in Modern Industry, handbook of industrial radiography, illustrated with 101 text illustrations

and 19 tables; 140-p volume. Comprehensible to experienced radiographer or student. *X-ray Div., Eastman Kodak Co.*

Circle No. 76, Pages 7-8

Taylor-made refractories, pocket-size booklet is a guide to selection of refractories. Gives detailed information on castables, cements, ramming mixes and patches. Indexed for handy reference. *The Chas. Taylor Sons Co.*

Circle No. 77, Page 7-8

Industrial truck catalog suggests sending "Hot Rodders" to school for safe industrial truck operation. Gives do's and dont's in handling for safety, economy and efficiency. *Elwell-Parker Electric Co.*

Circle No. 78, Page 7-8

Laboratory ware made of polyethylene (said to be chemically inert, inexpensive and unbreakable) is completely described, and priced in 16-p catalog. *Schaar and Co.*

Circle No. 79, Page 7-8

Silent chain drives covered in comprehensive book containing 88 pp of detailed engineering data of chain's versatility in wide range of applications. Has tables of service factors, a 16-p section of pre-engineered stock drives, 22p section on procedure for selection. *Link-Belt Co.*

Circle No. 240, Page 7-8

Sales training clinic for gray and ductile iron castings salesmen has been announced. Marketing salesmen will

be instructed on finding potential customers, qualifying them, and ways of dealing with industrial buyers. *Gray Iron Founders' Society.*
Circle No. 80, Page 7-8

Cupola control described in notes on production of high alloy Strenes metal—a gray iron with high strength, heat resistance, and abrasion resistance. *The Advance Foundry Co.*
Circle No. 81, Page 7-8

Telephone selling featured in new book *Adventure in Small Business.* Recounts ten year progress of firm. *Rolled Steel Corp.*
Circle No. 82, Page 7-8

Automatic cupola charging in foundry of Hewitt-Robins, Inc., fully described in well-illustrated 8-p technical article. *Whiting Corp.*
Circle No. 83, Page 7-8

Gray iron and non-ferrous castings production described from patterns through core room. Mold preparation, which includes shell molding, inspection and cleaning are shown with an illustrated brochure. *Berlin Chapman Co.*
Circle No. 84, Page 7-8

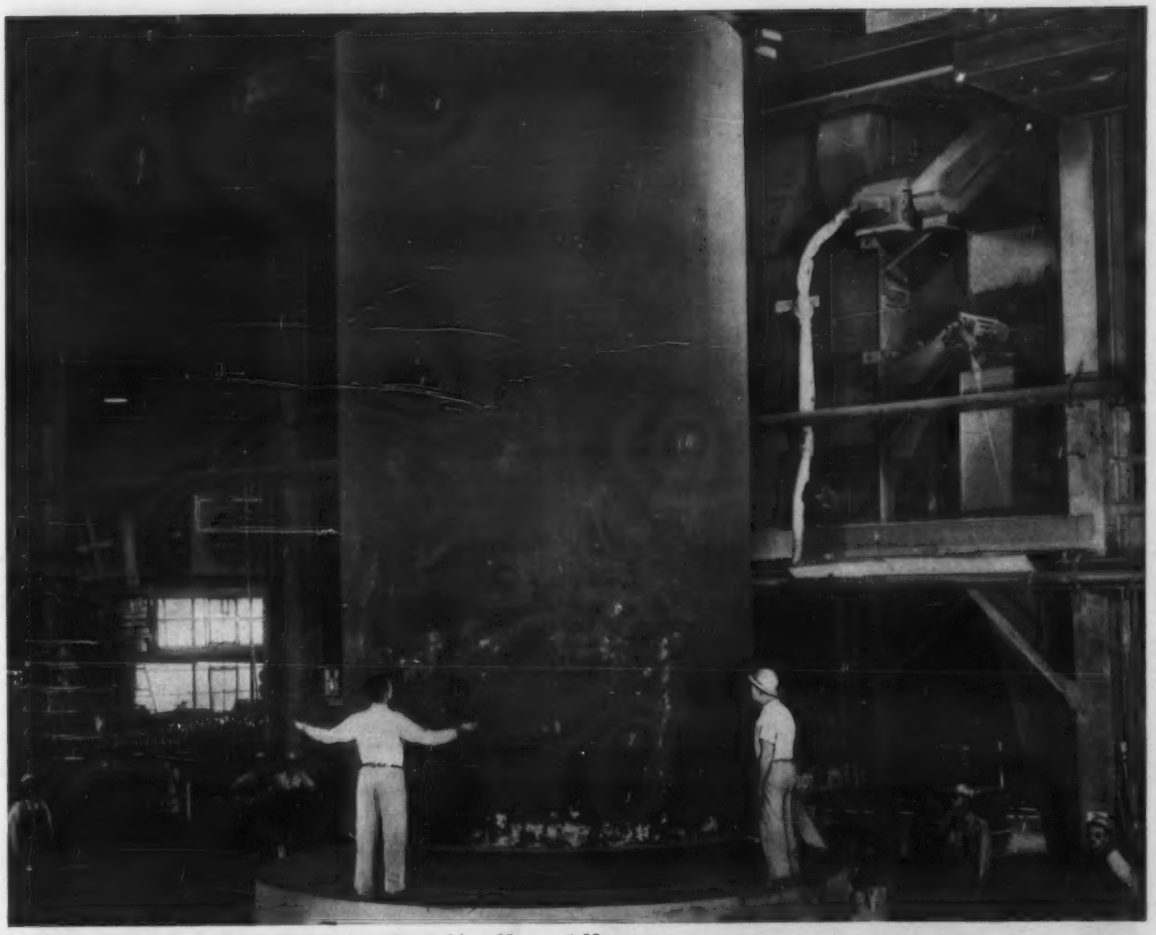
Air-setting binder claimed to reduce manhours by 50% in fabricating and shakeout operations, cut rodding and baking time. Accelerator and comparison charts included. *Archer-Daniels-Midland Co.*
Circle No. 85, Page 7-8

Business charts and services described in informative 16-p catalog. Company services such as reports, reference books, salesmens guide books, marketing services, municipal surveys, business charts, counsel to businessmen are also available for the asking. *Dun & Bradstreet, Inc.*
Circle No. 86, Page 7-8

Direct-driven fans, said to offer better performance in low static pressure ranges. Described and illustrated in 4-p bulletin. *Aerovent Fan Co.*
Circle No. 87, Page 7-8

Borolon tumbling abrasive for barrel finishing, catalog explains aluminum oxide abrasive chips and screened grain sizes for many uses—deburring, stock removal, breaking edges, and precision finishing to micro-inch limits. *Simonds Abrasive Co.*
Circle No. 88, Page 7-8

Magnesium and aluminum alloys catalog, lists physical properties and conforming specifications. Pictorial presentation depicts foundry operations in making sand and permanent mold castings. *The Wellman Bronze and Aluminum Co.*
Circle No. 89, Page 7-8



40-Ton Dryer Roll being removed from the mold at Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia.

How nickel cast iron helps take the risk out of large castings

Here's a Yankee dryer roll for example. It weighs 40 tons. Length: 262 inches. Diameter: 12 feet.

It's just too big to take a chance. The foundry can't afford a reject. Especially when a reliable metal can assure pressure tightness... ample strength... a smooth surface... and easy machining.

Nickel cast iron assures a sound casting through uniform metal structure

Nickel irons combine fine graphite in a uniform matrix. They promote strength and rigidity, and a surface free of imperfections.

Because of these properties Newport News specifies a nickel cast iron for these rolls. Even with today's high steam pressure this nickel cast iron dryer roll will stay pressure tight. It's definitely not a leaker. Its surface, thanks to nickel cast iron, is uniform and smooth.

The roll easily meets the strength levels required by the boiler code. The basic 1.34% nickel iron composition achieves 40,000 minimum tensile strength every time.

And Newport News needs nickel cast iron to get the high polish, mirror-like finish required on the roll. Uniform structure and the absence of carbides and defects afford a readily machined and polished roll.

You, too, can get this dependability in heavy iron castings – or in light ones that need high strength, pressure tightness and good machinability. Nickel cast irons are quality castings. And quality castings are good business ...for you, and for your customer.

For assistance on specific composition problems, contact Inco. Our engineers will gladly provide the metallurgical information you want.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO

NICKEL CAST IRONS

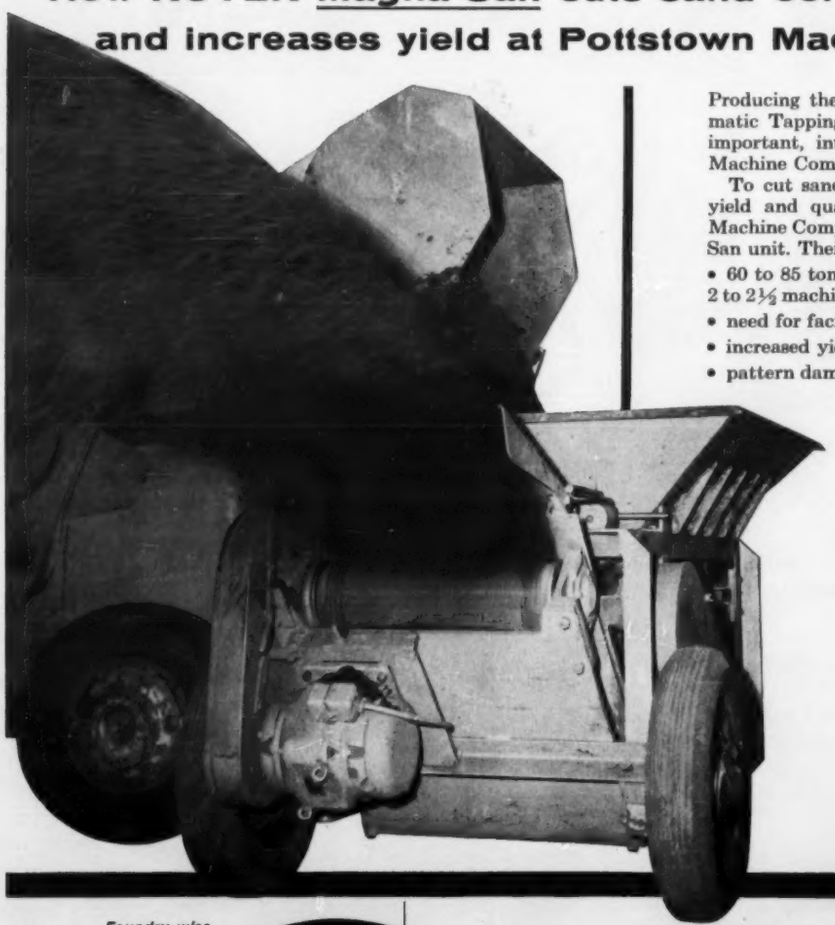
(Upper) Compact—Highly Portable . . . 60" x 90" size fits it into any layout . . . turns on 6½ foot radius . . . handy yoke hitch for crane moving.
(Lower) At Pottstown, Magna-San flanks each molding station with 20-foot windrow of cooled, perfectly conditioned sand.

15 cu. ft. hopper can be fed from three sides, as fast as a front end loader can be positioned. Note hopper grate to "hold up" large sprues, spills, etc.

Handling a very heavy sand at Pottstown, note fluffy, clean, thoroughly-aerated discharge. Rugged construction is typical of Royer.

End Result—a high-quality precision tool—Pottstown's internationally-known Automatic Tapping and Threading Machines for pipe fittings, valves, etc.

How ROYER Magna-San cuts sand conditioning costs and increases yield at Pottstown Machine Company



Producing the castings for their famous Automatic Tapping and Threading Machines is an important, integrated operation at Pottstown Machine Company.

To cut sand conditioning costs and increase yield and quality of castings, the Pottstown Machine Company chose the *new* Royer Magna-San unit. Their experience:

- 60 to 85 tons of sand perfectly conditioned in 2 to 2½ machine hours . . . only 4 to 5 man hours
- need for facing sand cut more than 50%
- increased yield of finest quality castings
- pattern damage cut to rock bottom
- a *new method* that makes entire foundry operation more clean-cut and straightforward

Magna-San magnetically cleans, mixes, blends and aerates up to 45 tons of sand per hour—at a lower initial cost and much less upkeep than any other mechanical method. Investigate this valuable addition to the facilities of *your* foundry—be it large or small. Write for detailed literature and the name of the service-minded Royer agent in your area.

Foundry-wise agents throughout the U.S. and Canada
EXPORT DEPT.
10406 South Western Ave.
Chicago 43, Ill.

ROYER

ROYER FOUNDRY & MACHINE CO.
155 PRINGLE STREET / KINGSTON, PENNA.
FOREMOST IN SAND CONDITIONING EQUIPMENT

Circle No. 139, Page 7-8

Conveyor systems for better material handling are covered in profusely illustrated book. Deals with major types of conveying equipment in use, purpose, difference in purpose, reducing cost-of-production. *Logan Co.*
Circle No. 90, Page 7-8

Maintenance equipment, 16-p book, gives prices, illustrations and description of countless office, factory, and warehouse items. Also covered are new products devised as executive planning aids, such as portable cabinet work bench, streamlined base cabinets, and over-the-floor electrical conduit for extension cords to eliminate tangled wires in office or shop. *Precision Equipment Co.*
Circle No. 91, Page 7-8

Belt conveyor pulleys catalog, 16 pp, for aiding foundrymen select proper pulley to do the job. *Jeffrey Mfg. Co.*
Circle No. 92, Page 7-8

Grinding wheel practice recommendations, 76 pp, supersedes 1947 edition. Arranged in two parts, Use Classification and Standard Shape Types and Sizes. *Grinding Wheel Institute.*
Circle No. 93, Page 7-8

Risering castings—reprint of an AFS exchange paper concerning steel, but principles also apply to other metals. *Nassau Smelting & Refining Co.*
Circle No. 94, Page 7-8

Shell mold casting booklet, 8 pp, presents a photostory of procedure. Also features quality control, design considerations, materials, and typical castings. *Westinghouse Electric Corp.*
Circle No. 95, Page 7-8

Ductile iron, 16 publications, covering specifications, applications and characteristics. *International Nickel Co.*
Circle No. 96, Page 7-8

Shell molding, how it was adopted by a small gray iron foundry, is told in news story form. *Durez Plastics Div., Hooker Electrochemical Co.*
Circle No. 97, Page 7-8

Sand booklet illustrates steps in obtaining and processing sand; lists 24 grades ranging from 25 grain fineness number to 400 mesh flour. *Wedron Silica Co.*
Circle No. 98, Page 7-8

Drafting and computation short cuts, tips are contained in 34-p bulletin. Illustrations and formulae are used to show time-saving methods. *Frederick Post Co.*
Circle No. 99, Page 7-8

Wood flour benefits in sand mixtures detailed in booklet describing results of adding cellulose materials to typic-

al synthetic molding sand. Sections on confined expansion, hot strength, and cleaning action included. *Eastern Clay Products Dept., International Minerals & Chemical Corp.*
Circle No. 100, Page 7-8

free films

■ **Motion pictures and other visual aids based on foundry processes and supplies are also yours *for the asking.* These films are suggested for formal or informal training groups. The owners of films in this column will send booking request forms to MODERN CASTINGS readers who circle the appropriate number on the Reader Service card (pages 7-8).**

Credit . . . Man's Confidence in Man, 16 mm sound film, 33 min available to business and educational groups. *Dun & Bradstreet, Inc.*
Circle No. 101, Page 7-8

The Road Ahead, color film, 23 min narrated by Walter Cronkite brings audience face-to-face with benefits expected from 41,000 mile, $50-billion interstate highway program. *Caterpillar Tractor Co.*
Circle No. 102, Page 7-8

Mechanization in Coremaking, 16mm, sound, 40 min film shows various types of the coremaking and coreblowing operations in 10 outstanding U. S. foundries. *Beardsley & Piper, Div. Pettibone Mulliken Corp.*
Circle No. 103, Page 7-8

Steel Valley, 18 min film narrated by Frank Blair dramatizes rapid strides made in development of special steels. Explains: the continuous formation of thin stainless steel strips from thick slab in 300-ft long rolling mills; the intricate rolling of titanium; and the part television plays in the rolling of great ingots. *Sharon Steel Corp.*
Circle No. 104, Page 7-8

Moving Mountains, 16 mm, sound, color, 27-min film portrays man's effort through the centuries to improve and speed his ability to move goods and materials. *Clark Equipment Co.*
Circle No. 105, Page 7-8

You and Labor Law, a two-part, 30-min sound slidefilm in color describes the history, purpose and principles underlying present labor law and shows present labor law in action. *Employers Labor Relations Information Committee, Inc.*
Circle No. 106, Page 7-8

The Shape of Things to Come, 16mm, color audio, 30 min, an effective presentation of the advantages of designing products around extruded aluminum parts. On location sequences filmed in 20 manufacturing plants over 13,000 mile area. *Reynolds Metals Co.*
Circle No. 107, Page 7-8

Size for size, Ohio Magnets lift larger loads over longer periods because they *operate cooler.* So for extra magnet lifting power, extra magnet value—always specify Ohio Magnets and Ohio Magnet Controllers. There's a type and size for every lifting job. Send for free copy of Bulletin 112, or consult the Yellow Pages for Ohio offices in principal cities.
AA-1477

THE OHIO ELECTRIC MFG. CO.
5400 DUNHAM ROAD • MAPLE HEIGHTS • CLEVELAND, OHIO

ohio ELECTRIC

CHESTER BLAND
President

Ohio Also Makes Separation Magnets • Nail Making Machines • Fractional Horsepower, Shell and Torque Motors

Circle No. 140, Page 7-8

Save COSTLY MASTER PATTERNS!

GET SCIENTIFIC Pressure Cast MATCH PLATES

We specialize in the casting of precision aluminum pattern duplicates. Plates are poured under pressure in one compact mold to assure accurate filling of ALL detail. Molding is done in plaster for extreme precision and uniformity.

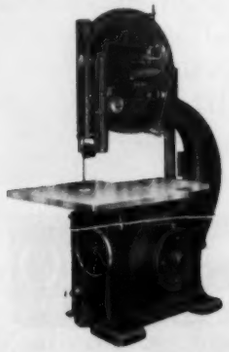
Write for FREE folder.

THE SCIENTIFIC CAST PRODUCTS CORPORATION
Serving Foundrymen More Than 20 Years
1390 EAST 40th STREET, CLEVELAND 3, OHIO
2520 WEST LAKE ST., CHICAGO 12, ILLINOIS

Circle No. 141, Page 7-8

OLIVER Band Saws produce finest work for pattern shops

The extra capacity and smooth operation of this Oliver Band Saw make it ideal for pattern shops. It takes 22" under the guide, 38" between saw and column. The table tilts 45° to right, 5° to left, and is self-locking. Its balanced ring-disk wheels run without vibration at highest speeds. Let this Oliver Band Saw save your patternmakers' time. Write for Bulletin No. 115.



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Circle No. 142, Page 7-8

the editor's field report

by Jack Schrum

■ To meet the challenge of space and speed, castings are being beneficiated in many ways—by alloying, refining, degassing, vacuum melting, chilling, and heat treating. Now comes another technique for squeezing the ultimate out of metals —press forging of castings. The Armour Research Foundation has been successful in its attempts to improve castings through warm and cold pressing. In this work, sponsored by the Air Material Command, U.S.A.F., parts are cast essentially to shape and then brought to finished dimensions by press forging in beryillium copper dies. Cold deformation is in the range of 25 to 40 per cent. For aluminum alloy 220, normal yield strength of 26,000 psi can be raised by this treatment to over 40,000 psi with a residual ductility of about 6 per cent. Magnesium alloy AZ92 has also responded well to pressing. The process is especially valuable to light metal alloys that cannot be improved by heat treatment.

■ The trend is toward castings—cast turbine buckets, that is. Jet aircraft engines are using more and more cast buckets, in preference to forged, because of their superior high temperature creep properties. All cast buckets going into the high-temperature turbine end are being made by vacuum melting and vacuum casting. Those destined for the cooler compressor end are being melted and cast in air.

■ Some of the automated foundry equipment in use today rival the complexities of an ICBM. For instance, the automated jolt squeeze green sand molding installation at Eberhard Mfg. Co., Cleveland, requires 250 electric circuits and 150 air and hydraulic cylinders to maintain a production rate of 600 molds per hour. Human failure to keep over 1000 lubrication points properly serviced has led to more automation—an automatic lubrication system for 80 per cent of these important spots requiring maintenance vigilance.

■ Iron briquettes are a new raw material for foundries appearing on the not too distant horizon. A large pig-iron producer in this country has developed a process which reduces iron ore directly, by-passing the blast furnace. The briquettes, weighing a few pounds, have an iron content of about 95 per cent, are the equivalent of scrap, and can be charged directly into electric and air furnaces. Experiments should soon prove whether the briquettes can be substituted for more expensive pig iron in the cupola. The process for making the briquettes can use any grade or type of iron ore, requires equipment far cheaper than a conventional blast furnace, and uses low grade solid fuels. Watch for this new material—iron briquettes may be in your foundry future.

Industrial Growth Depends on Professional Managers

BY GLENN J. COOK / *Manager-Marketing*
General Electric Co.
Schenectady, N. Y.

■ The most important factor in business profits is the quality of management. Results in this area of personnel development are very difficult to measure. The extent to which the business is developing managerial leadership and other skills in people may well determine whether the business will continue in the years to come. Failure in this area will doom a business to eventual decline.

Balanced Attention

It is important that all functions of the business receive balanced attention. Most foundries seem to concentrate great attention and do an excellent job in the area of direct shop operations work and production scheduling. These manufacturing functions tend to command the lion's share of general management attention.

This leaves five other functions which require balanced attention; legal, finance, engineering, public and employee relations, and marketing. Legal work is usually not a serious problem. Counsel can be obtained from a competent local attorney.

Some of the less glamorous facets of finance such as cost accounting appear to get far too little attention; if we do not know our costs, we can hardly expect to make profits. Regarding engineering, there are still very few research and development laboratories in the industry. The castings industry rates low in ratio of expenditures for research and development compared with sales.

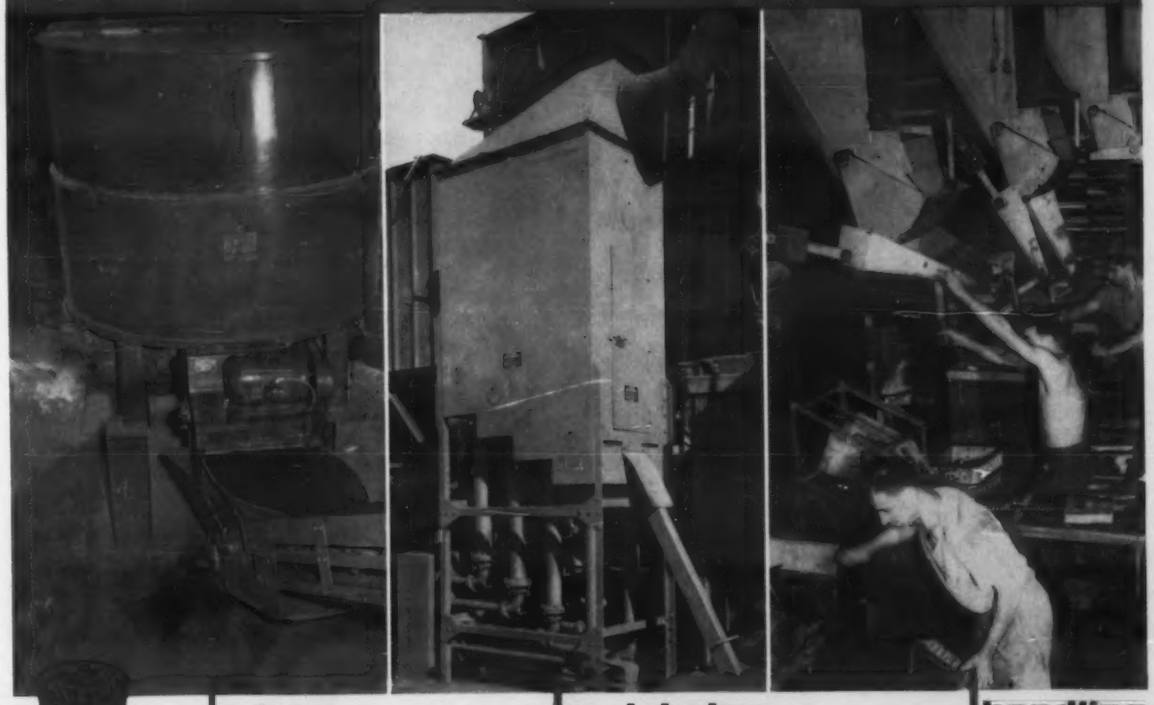
Public Relations

Foundries tend to be somewhat inadequate in their employee and public relations. Not every foundry has a really adequate health and safety program. In the field of communications we all shrink from the huge task of informing our employees, the community neighbors, government officials, and others whose goodwill and understanding we need.

The function which seems to be in greatest need of more professional attention is marketing, which includes far more than just sales. This is an area where far more attention must be directed if foundries are to improve future growth prospects. Progressive foundries meet competition in planning, as well as production.

■ *Condensed from a talk presented at the AFS New England Regional Foundry Conference, Oct. 19, 1957.*

NATIONAL Means Equipment and Service for BETTER Sand Practice



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• The services of your National Engineer have been broadened through the years to offer practical, experienced assistance in every phase of sand handling, molding and casting practice.

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These are but a few of the reasons why when you *buy National* you buy products of the practical foundrymen . . . made for the foundry, *by* foundrymen.

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MANUFACTURERS OF SIMPSON MIX-MULLERS
Circle No. 143, Page 7-8

Castings Meet Challenge of Space and Speed

CHANCE VOUGHT USES MORE STEEL CASTINGS

S. K. HODGSON / *Staff Engineer*
Chance Vought Aircraft, Inc.
Dallas, Texas

The castings industry should be encouraged to learn that aircraft and missile manufacturing costs are being reduced by a constantly growing trend toward the use of steel castings.

With Chance Vought this trend started when we ordered our first steel investment casting in 1941. Today our F8U-1 Crusader flies with the aid of 72 steel castings and our guided missile—Regulus II—utilizes 57. Largest casting weighs 285 lb, measures 48 in. long, and is made of 4330 steel. About 40 per cent of the castings are investment cast. Alloys receiving most use are 410 and 17-4PH stainless steels and 4140 alloy steel.

Principal difficulties experienced in processing airframe castings are:

- Delivery on schedule of samples and production castings,
- Quality of castings measured by x-ray and magnetic particle inspection,
- Dimensional tolerances.

The Regulus II guided missile utilizes 57 steel castings in its construction. Many of the castings exceed the size normally cast by the investment technique. These larger castings are being produced in shell, ceramic, or core sand molds. Heat treatment alignment fixtures are usually needed to insure dimensional accuracy.

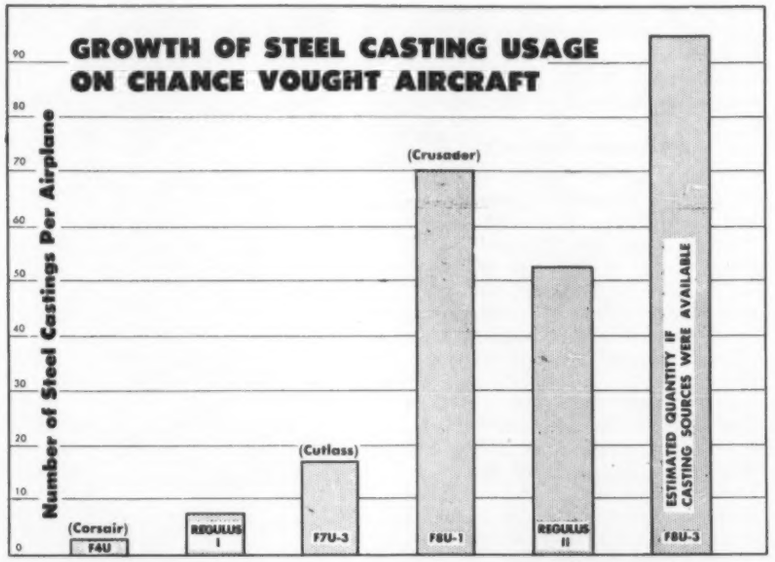
Regulus II was first publicly flown on Dec. 10. The 1200 mph missile is 57 ft long, has an extended range of 1000 miles, and can land on its own landing gear.

Missile Castings

Two fuselage machine fittings for Regulus II are illustrated. The upper casting weighs 3.1 lb and lower, 3.5 lb; both are 410 stainless steel poured in shell molds. These parts are too thin to forge to size. Even if sections were heavier, the die closure tolerance would exceed that across parting line of shell molds.

The surface control bellcrank shown on next page, operates at 400 F directly over afterburner. It is a 3.5-lb, 17-4 stainless steel casting made in ceramic molds.

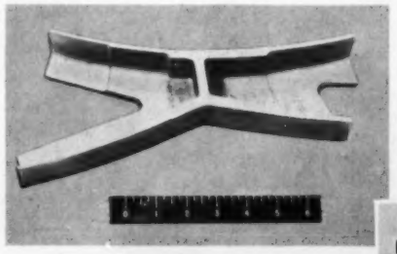
Seventy-two steel castings, in-



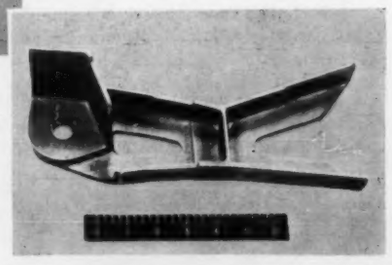
More castings in aircraft as means of cost reduction is the trend.

BULLETIN: Chance Vought Aircraft has been awarded a $1,093,854 Air Force contract to develop foundry methods for casting high strength steel alloys for supersonic aircraft. Chance Vought will select three foundries to produce castings for aircraft that will reach speeds in the range from 1500 to 2300 mph. Parts for such aircraft must withstand temperatures to 1000 F.

Regulus II guided missile built by Chance Vought for the Navy uses 57 steel castings and more applications are now being developed.



Fuselage fittings for Regulus II are stainless, cast in shell mold.



These parts are cast because they are too thin to be forged to size.

cluding 21 ground handling items, are used in the manufacture of the F8U-1 Crusader plane for the Navy. Materials used are 410, 17-4, and 347 stainless steel and 4130, 4140, 4330, and 4340 alloy steels. All 410 stainless steel is heat treated to 180,000 psi minimum tensile strength.

Aircraft Castings

The engine removal track fitting illustrated weighs 3.9 lb and was produced in a ceramic mold. Also made by shell molding, this part is cast in 17-4 or 410 stainless steel to operate at 500 F. The web areas are only 0.12-in. thick—too thin to forge to size.

Three gun mount fittings for the same plane are shown. Investment cast in 410 stainless, the base plate is only 0.12-in. thick. Test castings were undamaged after 10,000 round firing tests. One set of these castings weighs 4.2 lb in marked comparison with the 65 lb of steel bars which are needed by the machine shop to "hog out" a set.

A slotted part used in both the F8U-1 and the Regulus is cast instead of forged to get slot to finished dimension and have better weight control without machining.

Other stainless steel castings in the F8U-1 are the outer panel leading edge droop hinges and gun gas cylinder sleeve bracket.

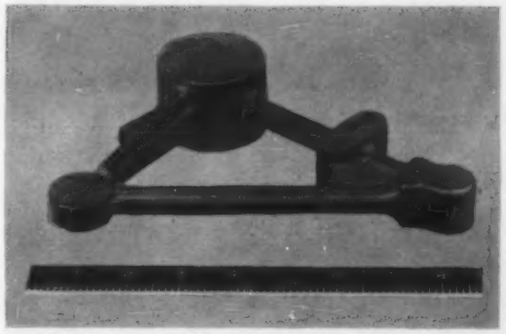
In order to reduce cost of ground-handling equipment for missiles and planes, Chance Vought engineering has recommended extensive use of steel castings.

Launching frame castings for Regulus II are made of 4330 steel. The largest weighs 285 lb, measures 48-in. long, is heat treated to 150,000 psi minimum tensile strength, and has withstood 400,000-lb static load. Attempt is made to control dimensions on this large casting to ±0.003 in./in. with a ±0.03 minimum.

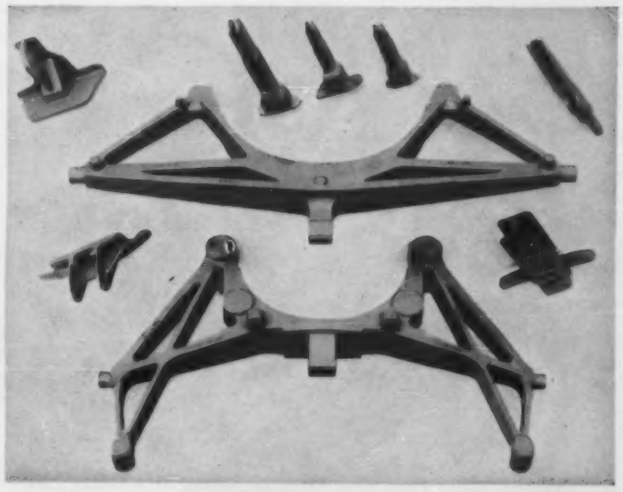
A variety of spanner wrenches for ground handling the F8U-1 are shown on the next page. Investment cast in 4140 steel, they replaced tools previously machined from steel plate.

Heat treated to a 125,000 psi minimum tensile strength, these wrenches are received from the foundry cadmium plated and with a square hole held to +0.005 to —0.000 in. tolerance by broaching.

Success with the steel cluster castings shown has led to placement of a 40,000-lb order. Each catapult cart used abroad carriers for launching the Regulus I, an earlier missile, uses 20 of these clusters, weighing a total of 537 lb. Although the cart is assembled

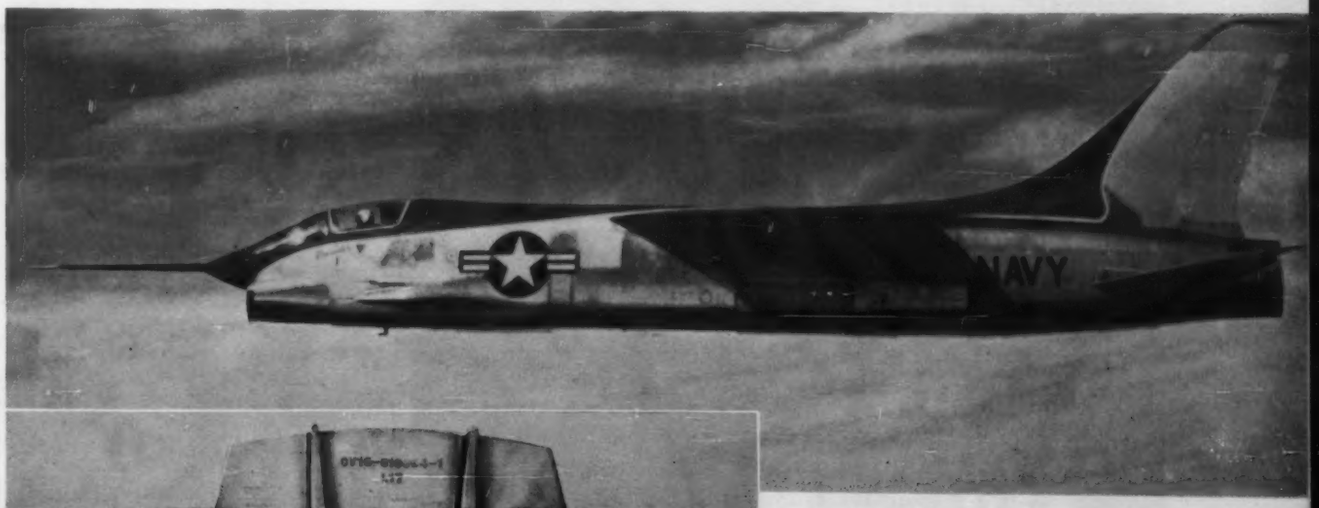


Bellcrank must operate in 400 F atmosphere.

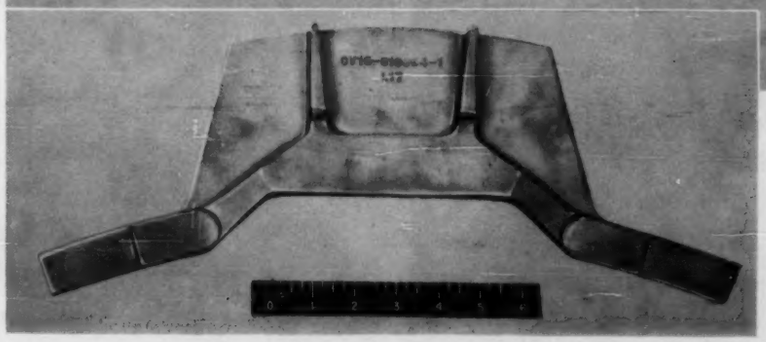


Launching frame castings must absorb the blast unleashed by the Regulus II missile on take-off.

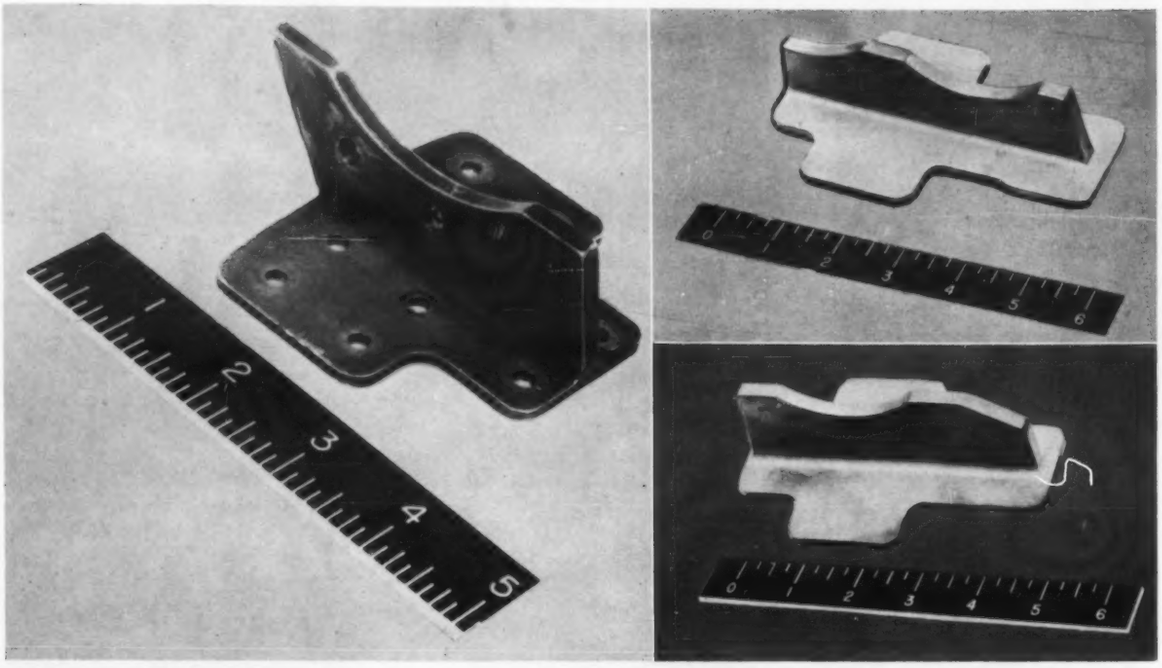
Cluster castings are assembled into catapult cart without machining.



F8U Crusader is a high supersonic speed fighter built for the Navy by Chance Vought Aircraft Corp.



Web areas of engine fitting are 0.12-in. thick, too thin to forge.



Gun mount fittings cast in 410 stainless with 0.12-in. thick base were undamaged after firing 10,000 rounds.

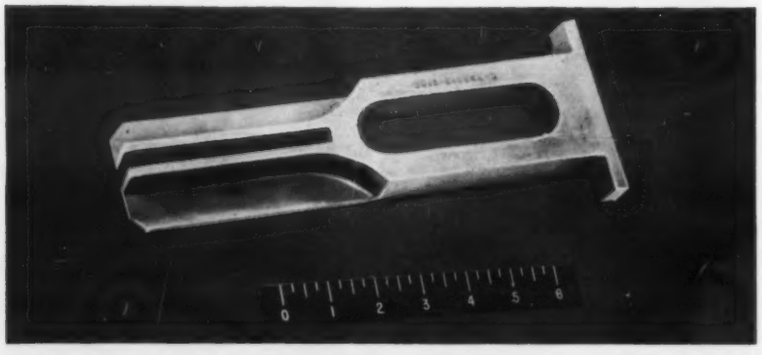
Vought aircraft have not by any means been exhausted. Daily tests continue with the goal of substituting less expensive, dependable castings for costly forged and machined components.

The Chance Vought F8U-3, a new aircraft design now being developed, will show the value of investigating castings applications. This aircraft and its ground-handling mechanisms will use 95 steel castings.

Other F8U-3 cast components are: control system link—4140 steel; engine removal track fitting—17-4 stainless steel; rear engine mount fittings—17-4 stainless steel.

Steel castings are fast attaining the recognition they deserve from the aircraft and missile industry. Current events indicate that the castings industry will occupy a more prominent position than ever in the national security programs.

■To obtain single additional copies of this article, circle A, Reader Service Card, pages 7-8.



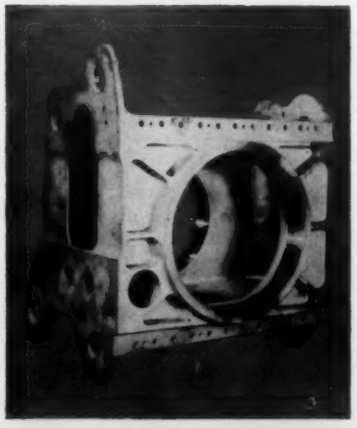
This part is cast to hold slot to dimension and to control weight.

in "tinker toy" fashion, no machining of sockets is needed.

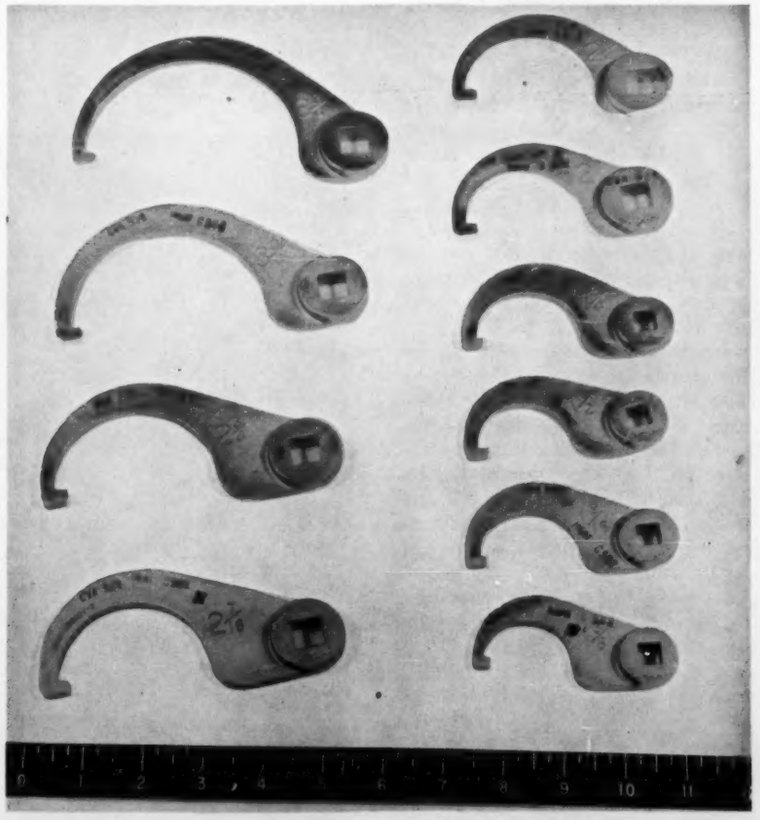
More to Come

Not all of the problems have been solved. Illustrated is but one of many challenging problems. This horizontal bearing housing has a finished weight of 29 lb. Many were made from 306-lb hand forgings. Current production is being machined from 108-lb die forgings. This part can be cast with a weight of 32 lb but has not yet been able to meet the severe mechanical properties required.

Castings applications in Chance



Unsolved problem: 32 lb housing.

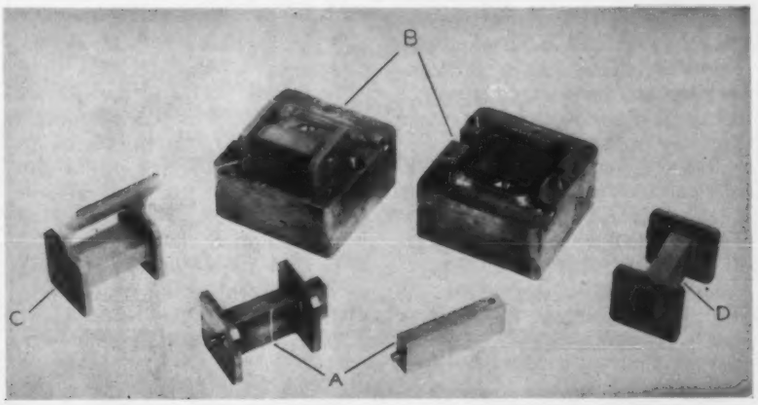


Spanner wrenches cast in 4140 steel replace tools machined from plate.

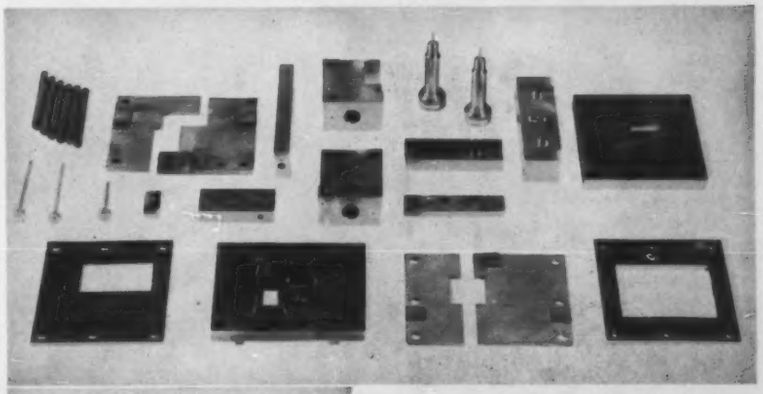
PRECISION CASTINGS GUIDE RADAR SIGNALS

K. L. HERRICK / *Process Engineer*
Arwood Precision Casting Corp.
Brooklyn, N.Y.

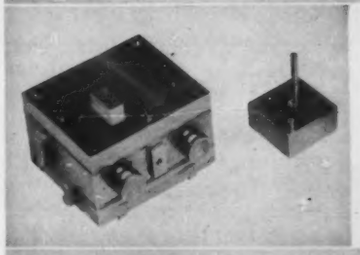
SAMUEL LIPSON / *Metallurgist*
Frankford Arsenal
Philadelphia, Pa.



Equipment needed to produce casting (D) known as wave guide cavity. Pictured are the master patterns (A), die (B), and wax pattern (C).

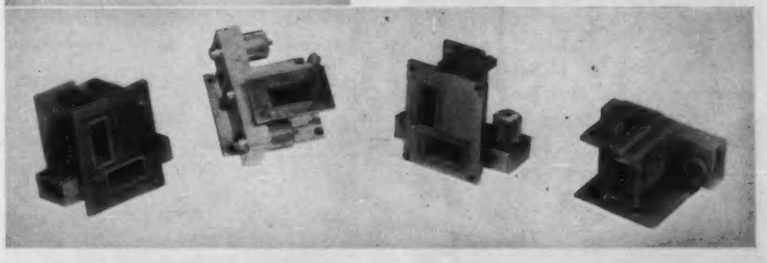


Components of die for wax pattern



RF Head Wave Guide

Assembled die



Patterns and finished parts.

Radar is the keystone of modern military techniques, and castings may be the keystone of the solution to a major problem in the design of radar equipment.

The manufacture of radar wave guides has relied on fabrication techniques requiring accurate machining and assembly by a dip brazing operation. This practice is costly, and warpage resulting from brazing causes non-uniform operational characteristics. As a result of these difficulties, the current trend is toward investment castings for these parts.

The first efforts to produce wave guide components as castings were directed toward the less complex shapes, but the success of these attempts has generated a great deal of pressure on the casting industry to produce more complicated designs.

Fabrication costs rise steeply as the complexity of the design increases, making the cast component more and more attractive economically.

■ Dimension Problems

Dimensional tolerances usually specified for wave guide components appear to be too close for the investment casting process. Often, these tolerances are established on the basis of the problems encountered in other forms of manufacture and are unrealistic when applied to castings.

One of the virtues of casting is that it produces a more uniform product than brazed fabrication. Deviation from the specified dimension for any given area of the casting can frequently be compensated by external adjustments to the system.

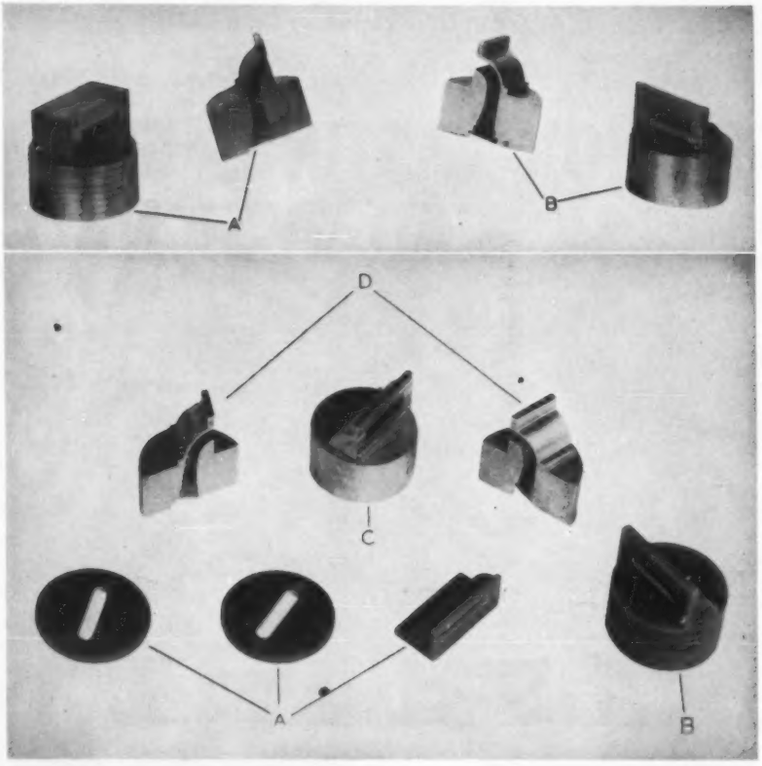
This article will describe the casting of a variety of components which were used largely in the development of prototype systems. The tooling and methods developed can be applied directly when quantity requirements for these castings develop. Castings were poured in silicon bronze and aluminum alloy 40E.

■ Pattern Dies and Components

Dies used in making wax patterns were made by two methods: 1) machining die parts from brass, steel, or aluminum; 2) casting a fusible alloy around a metal master pattern. Machined dies are used mainly where the complexity of the wax patterns to be made from the die are such that a fusible alloy die is not practical. However, the fusible alloy dies are suitable for most parts.

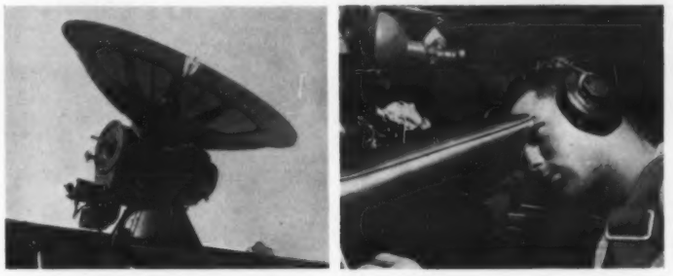
Wave Guide Cavity. The photo, page 29, shows the master pattern,

■ To obtain single additional copies of this article, circle *B*, Reader Service Card, pages 7-8.



Uniformity of cast part (B, top) is superior to dip-brazed assembly (A, top). This 90° stepped-twist bend is produced with wax patterns (A), also shown assembled (B). Casting (C) is also shown in section.

WHAT ARE RADAR WAVE GUIDES?



Wave guides carry radar signals from antenna to receiver.

■ Radar wave guides are electronic plumbing. Wave guides carry radar signals from antenna to receiver just as pipes carry water from the well to the spigot.

Radar is a radio signal broadcast at an extremely high frequency. Radio waves broadcast at such frequencies cannot be conducted on wires, but must be conducted through hollow metal piping. These pipes are called wave guides and are used to connect transmitters to transmitting antennae and receivers to receiving antennae.

To confine waves to the interior of the guides, very close dimensional tolerances must be maintained. If the dimensions of the wave guide vary beyond the tolerances, the waves will be radiated into space or converted to heat and lost. The surface smoothness and dimensional accuracy required in cast wave guides may exceed those of any other castings ever produced.

fusible alloy die, wax patterns, and a sample casting of the wave guide cavity. A fusible alloy die was used because the part is of such a shape that a two-part die can be easily made. The master pattern and core are brass.

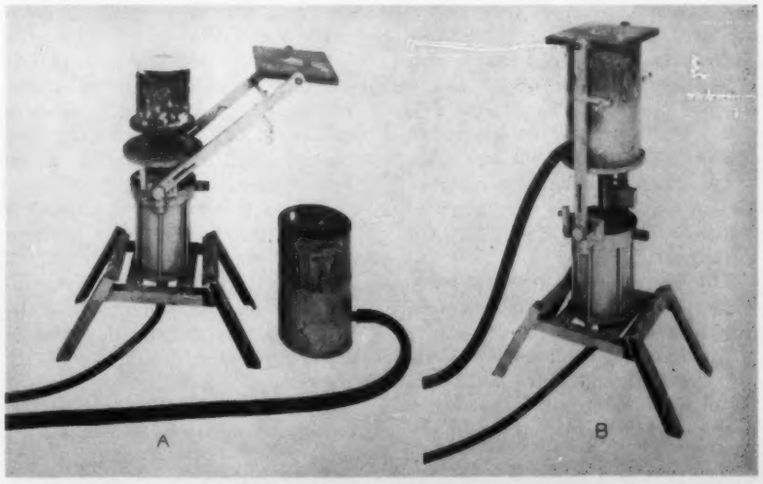
Casting the RF Head. The wax injection die for this part was machined of brass because of the complexity of the wax pattern to be made and because of the dimensional control necessary (±0.001 in. to ±0.003 in.) on the final casting. Brass was chosen as the die material instead of steel because of machinist preference to work with brass rather than steel. The added wear resistance afforded by using steel was not necessary because a relatively small number of wax patterns would be made.

To better determine the die dimensions which must incorporate shrinkage factors, a mock-up fusible alloy die was made from a mock-up master pattern first. This mock-up was very similar in size and shape to the RF head. All of the process variables were carefully controlled and recorded so that shrinkage factors could be obtained by measuring the die and the final casting. This information facilitated machining of a satisfactory brass die.

The assembled die is shown on page 29 along with a sample wax pattern. The threaded bosses were made in the smaller die and assembled on the wax pattern shown at the right.

This die was designed in such a way that if the original dimensions were not satisfactory, minor changes could be made by inserting shims between the layers or milling off small amounts of metal. Radical design changes could also be made simply by making different die parts. Different castings could be made from the same die by using a variety of inserted die parts. Two of the cores had to be split to facilitate removal from the wax pattern after the die was injected. One cored area had an iris and another had two depressed slots in the wall. Two of the assembled wax patterns ready for investing and the finished wave guide assemblies are shown.

90 Degree Stepped-twist Bend. Steel dies were used to make the



Castings were poured in device that holds mold in a vacuum chamber. When closed, only sprue opening is exposed to atmospheric pressure.

component wax patterns for this part. Wax pattern components, an assembled wax pattern, and some finished castings of the part are illustrated on page 30. These wax pattern disks are made individually and are assembled to give the stepped-twist. The bend portion of the wax pattern was made in another die which incorporated a circular core print for drawing the core after wax injection.

■ **Wax Injection and Gating Setups**

The wax patterns were produced on a low pressure, air operated, bottom injection machine. The wax temperature was maintained at 200 F; injection pressure was 40 to 80 psi; fill time was approximately 20 seconds; dwell time was 1 to 2 minutes. In all of the components it was necessary to apply air pressure to the die opening immediately after injection to eliminate depressions in some sections of the pattern.

The wax injection cycle for the RF head patterns in the brass die was controlled very closely, and special precautions were taken to keep it constant for all of the patterns. This injection cycle was the same as was used for the mock-up die of the RF head. Other variables which were controlled with the RF head patterns were: time the wax pattern was left in the die after injection, storage time, and temperature. When wax patterns had to be assembled, acetone was used as an adhesive for fastening the pieces together.

Whenever possible, the same gates used for wax injection were used for mounting and gating the wax patterns for investing. This arrangement was possible with the wave guide cavity. Two patterns were mounted on a 5 in. diameter base, and a 5 in. diameter x 5 in. cylindrical flask was sealed on with wax.

Mounting of the 90 degree stepped-twist bend consisted of adding two 3/4 in. diameter runners adjacent to the core. One pattern was attached to a 4 in. diameter base, and a 4 in. diameter x 4 in. cylindrical flask was sealed to the base with wax. The RF head was gated with three 1/4 in. diameter gates attached to the large flange. One pattern was mounted on a 5 in. diameter base, and a 5 in. diameter x 5 in. cylindrical flask was sealed to the base with wax. All patterns were cleaned with methyl alcohol prior to investing.

■ **Investing**

The investment material used for all molds was a proprietary investment material consisting essentially of 70 per cent silica and 30 per cent gypsum. The investment slurry used had a ratio of 45 parts of water to 100 parts of investment with 0.1 per cent agar solution added.

The slurry was prepared in a mechanical mixer, the ingredients being mixed for 3 minutes. Then the mix was placed under vacuum until a boiling action took place. The slurry was poured into the cylindrical flasks containing the molded patterns. Flasks were vacuumed and allowed to bubble slightly, then removed and additional investment added to fill them. The setting time of investment was approximately 15 minutes.

All flasks were placed in an upright position, sprue down, in a high temperature burnout furnace and subjected to 15 hours burnout. This burnout vaporizes the wax and calcines the plaster mold. The burnout cycle is automatically controlled with a cam on the furnace temperature regulator. The cycle is 2 hours at 250 F; raised 100 F per hour until 1200 is reached; allowed to remain at 1200 F for approximately 4 hours; followed by cooling to the proper temperature for pouring.

■ **Casting**

Aluminum alloy 40E and silicon brass were used to make these components. Metals were melted in open clay-graphite crucibles in a gas-fired melting furnace. Small melts, in the 5-to-10 lb range, were used.

Pouring temperatures were checked with an immersion type pyrometer. The table shows the mold temperatures and metal pouring temperatures which provided the best results.

All molds were poured in a vacuum casting machine developed at Frankford Arsenal. The mold is enclosed in a vacuum cham-

Continued on page 68

Plaster molds for large aluminum wave guides are made in this area.

Castings Meet the Challenge of Space and Speed

MORRIS BEAN & CO. CASTS WAVE GUIDES ±0.003"

Radar wave guides and feed horns for microwave systems in the range of 6 in. to 4 ft in largest dimension are being produced in plaster molds at Morris Bean & Co., Yellow Springs, Ohio.

The accuracy maintained depends on the size of the wave guide opening, but the absolute tolerance permitted on certain openings in small sizes is ±0.003 in. All castings are furnished with openings which measure between these limits. Extreme accuracy and smoothness are the prime considerations, but pressure tightness and fatigue endurance may be required.

Center wall 0.032 in. thick.

Ribbed casting is stronger.

Guides with compound bends.

Castings Meet the Challenge of Space and Speed

HOWARD FOUNDRY BUILDS QUALITY into AIRCRAFT CASTINGS

BY CHARLES F. MAXWELL /
Chief Metallurgist
Aluminum Div.
Howard Foundry Co.
Chicago

Quality castings will be the contribution of the metalcasting industry to the conquest of space and speed. Quality aluminum and magnesium castings have already played an important part in building the missiles and aircraft that now probe at the outer limits of knowledge.

Castings for these air-borne vehicles must incorporate the best quality possible to produce with current technology. Quality in castings is more than opinion, it is the measured performance of a foundry in producing complex as well as simple parts in accordance with the highest standards assigned.

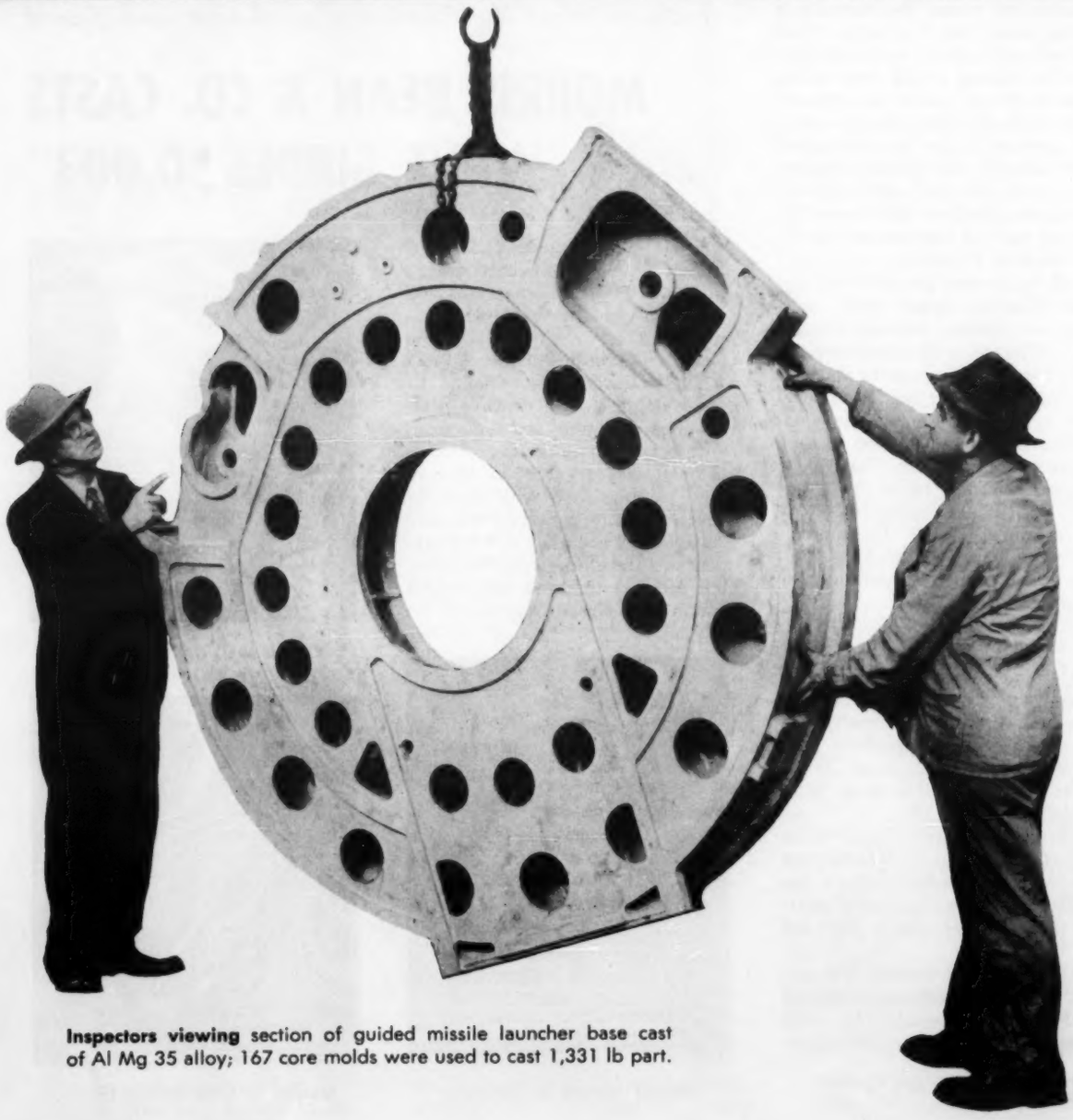
The production of quality castings is the direct result of a system which controls every step in the production technique.

Producing castings for aircraft and missiles is a short-run business and falls into the province of the jobbing foundry. A system of quality control for a jobbing plant must be prepared to produce the highest quality in a single casting or in a run of several thousand pieces from a wide selection of alloys.

This discussion will detail all the procedures used by Howard Foundry Co. to produce both simple and complex aluminum castings.

Work scheduling in the jobbing foundry changes more on an hourly basis than it does daily or weekly. Therefore, any quality control system must be versatile enough to compensate for such alterations.

No system, regardless of how well planned, can exist without the full cooperation of management, supervision and labor. The quality control program functions through the medium of the laboratory and



Inspectors viewing section of guided missile launcher base cast of Al Mg 35 alloy; 167 core molds were used to cast 1,331 lb part.

■ To obtain single additional copies of this article, circle C, Reader Service Card, pages 7-8.

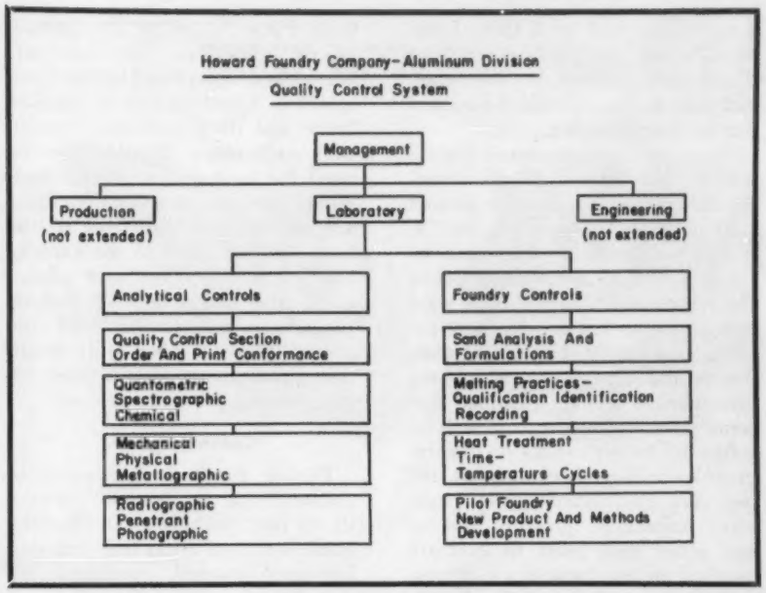


Fig. 2 . . Quality Control System, showing analytical and foundry laboratory control for production in accordance with high standards.

Fig. 3 . . Castings manual to spell out casting operations.

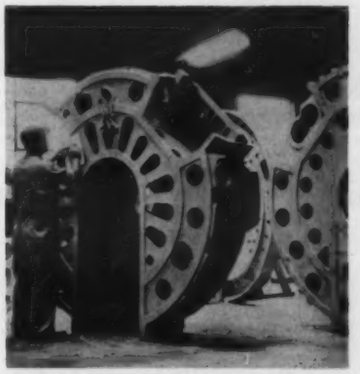


Fig. 4 . . Using reference chart to pin point control.

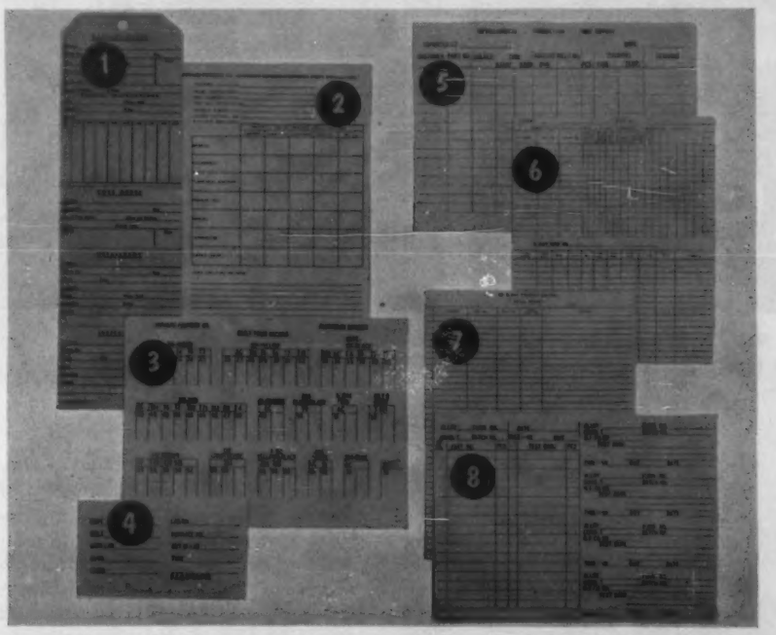


Fig. 5 . . Some of the forms and records Howard Foundry uses in its program to increase product quality through better quality control.

merges with the requirements of the production and engineering departments. Integration of activities in the departments is the key to casting quality.

For a laboratory to offer suitable recommendations for corrective action of any kind, it must first have access to all facilities; and freedom to investigate the sources of all contributing factors leading to the condition or conditions to be corrected. Such provision has been made in the "Quality Control System" (Fig. 2), since it encompasses the two main headings, one classified as "analytical" and the other as "foundry".

Under the first group there are 18 men and under the second, 50; most of these men are non-technical. With few exceptions, those regarded as technical have become so classified through a course of progressive in-plant training.

Ingot Specifications

Since quality aluminum castings are largely dependent upon the quality and control of raw materials, certain standards have been established to govern the purchases of such material.

Practically every aluminum alloy has specifications devised by technical societies, government agencies, and even by the customer. Slight variations of element concentration or range can be the cause for rejection of parts under the terms of one specification, while under the terms of another, they may be quite acceptable.

Since any one of these specifications may appear on a customer's order, rigid requirements have been established for buying aluminum ingot. All ingot is purchased with these conditions stipulated plus a requirement that vendor's certified report be forwarded prior to or with the shipment. Upon the receipt of material, an ingot from each lot is sectioned and submitted to the laboratory for complete analysis before release to the foundry.

This procedure affords a more reasonable safety margin when considering the possibility of intra-laboratory dispute on margin determinations.

Permanent records are kept of all ingot analyses and are often used as a basis for blending lots of similar alloy in order to favor a particular element.

Knowledge that the average composition of all scrap gates, risers or castings is within the tolerances for the alloy permits melt charges to be made combining scrap with new ingot in such ratio as to maintain a near constant balance with casting yield.

Keeping Records

Good records are a prerequisite for quality control. In the compilation of master file data, an industrial photo laboratory is an invaluable tool. Its value is shown in Fig. 3. Preparation of this manual for a complex casting containing some 27 cores eliminated any need to depend on memory to do the job right when a repeat order came in many months later.

Contained in this casting manual

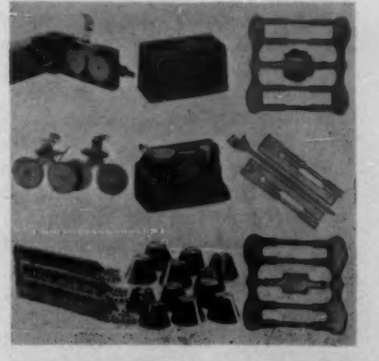


Fig. 6 . . These test specimens required for qualifying melts. Left, permanent mold; center, core mold; right, bar designs.

Fig. 7 . . These castings are 100 per cent x-ray inspected.

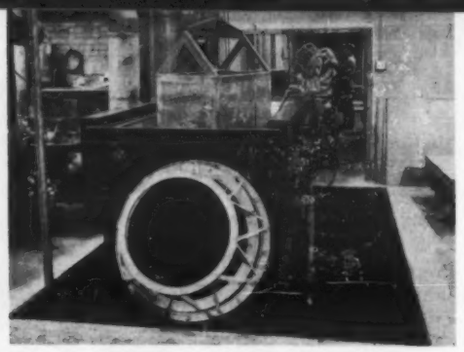


Fig. 8 . . Aircraft part and its dye-penetrant inspection.

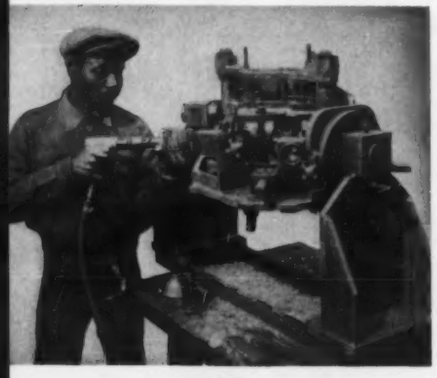


Fig. 9 . . Targeting fixtures spot face points of castings.

Fig. 10 . . Castings layout to check dimensional tolerances.

are 78 photographs and descriptions of each step of assembly including a permanent record of the gating and risering system. A set of 6 zone charts made it feasible to locate any specific area of the part required in the course of subsequent reference between plant and customer. Lower left hand photo in Fig. 3 shows such a handy reference-zone chart.

Figure 4 shows how such charts are used in the shop—in this case to locate areas requiring specific dimensional and condition control. The aluminum casting being charted is from a mold constructed by the assembly of 174 cores. Note the six-view zone assembly chart at lower left and test bars attached to the casting which is being prepared for stabilization treatment.

Some of the more important records forms are shown in Fig. 5.

Form No. 1 is a four-section card issued to the corresponding departments from the production office. Each section carries the basic information obtained from the customer's order. Using the metallurgical card section, the metal quality control inspector obtains latest print for part from engineering department and transcribes all relavant specifications and/or procedures to Form No. 2. This form becomes the first part of a master file which includes all materials, methods, charts, and photographs.

Each department directly effected by a particular specification is provided a copy of such requirements. The quality control section must see that all instructions have been carried out before submitting the castings for direct shipment or shipment through the resident government inspectors or customer source inspectors.

Melt Quality

Form No. 3 represents the melt identification system and shows the basic code for obtaining a chronological sequence to castings having the same composition and thermal treatment. Each two-digit prefix is a constant and immediately identifies both the alloy and its condition while its composition is related to a particular melt by a three letter alphabetical progression system. These melt numbers and letters are assigned to the individual furnaces during their charging cycle.

Since any melt prepared from a 400 lb., 1000 lb. or 1750 lb. capacity tilting furnace may be poured into castings representing an "X" number of customers, there can be no deviation of melt quality below the requirements of the most rigid among them. Not being in any position to identify these in advance due to the very nature of jobbing schedules, it must be assumed that some portion of every melt will be subjected to customer's or government laboratory check analysis, 100 per cent radiographic and penetrant inspection, pressure test or any other tests used to evaluate physical or mechanical conditions.

Therefore, ample proof of such melt quality must be completed just prior to the actual pouring of the castings. This requires the full co-operation of all concerned since it involves precise timing. In order to accomplish this correlation of melt procedures, all furnace tenders, furnace tender helpers and skimmers, as well as all alloy recorders, samplers and casting stampers are under the direct supervision of the laboratory.

All melts are qualified by a three-step method which determines for sand castings 1) composition 2) relative gas content and 3) pouring temperature. For permanent mold castings it determines 1) composition, 2) mechanical properties and 3) pouring temperature.

The basic distinction lies in two facts: first that the gas content of a permanent mold melt is less evident since some portion, if present, is retained in solid solution due to rapid cooling; and second, the fact that in determining the "as cast" tensile strength values of such melts prior to pouring, the presence of gas would be reflected. Since few or no "as cast" values are published particularly for heat treatable aluminum alloys, property levels have been established to insure the detection of gas and also the maximum response to heat treatment.

After a melt has reached an homogenous liquid stage in the furnace, the preliminary spectro-discs are poured and submitted along with Form No. 4 to the quantometric laboratory. The analysis is generally completed within three minutes. Every sample is sparked twice and their patterns recorded over each other. Should there be need for melt composition adjustment, the necessary calculations are recorded on the back of the form and returned to the furnace room foreman. After melt adjustment, the sampling and analysis procedure is repeated until the composition has been fully qualified. Final chemical test discs are then poured for customer use.

Removing Gas

During the period devoted to chemical analysis, the melt receives its dry nitrogen treatment. Flushing continues until a gas free test slug has been poured, machined, inspected by qualified personnel and recorded. Ten minutes are required for this gas test preparation.

Figure 6 shows the test specimens required for the qualification of any melt. At left is the two-cavity permanent mold with the spectro discs it produces. Center shows the core mold and the conical slug produced for gravity solidified gas content determination. At right top and bottom are two sand cast test bar designs and one permanent mold design.

Tags in evidence on several of the views are used for identification. These are prepared from 1 x 0.010 in. pure aluminum strip cut to approximately 4-inch lengths. Each tag is impression stamped with its previously assigned melt number before being inserted into the liquid sprue or riser of each casting.

Pouring Records

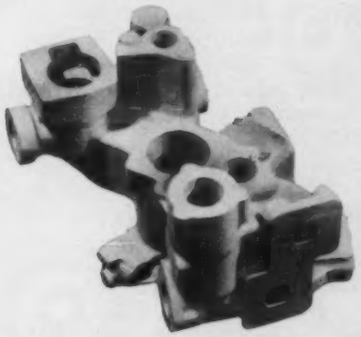
In the use of Form No. 5, (Fig. 5), quality control men account for the number of pieces poured from each melt, the order number, the time of pour, and pouring temperature. In addition to its laboratory use, this information is used by cost department, production department, and government offices.

All the molding materials are checked by a sand technician. In order to control molding materials it is also necessary to control those who prepare the pre-established production mixture. Consequently, all muller operators and loaders for

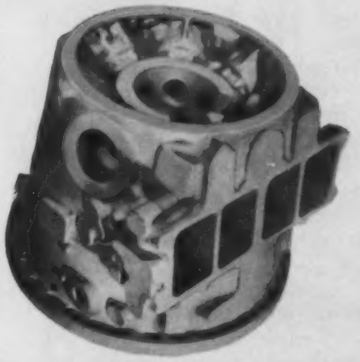
THESE HOWARD FOUNDRY CASTINGS MEET THE CHALLENGE

Aircraft control housing is 3 lb Al part cast by all-core mold process.

Jet engine compressor case and combustion cover is Mg casting.



Aircraft carburator part is 21 lb aluminum casting in all core mold.



Jet engine rear assembly drive, a 132-lb magesnium alloy casting.

Front housing assembly drive for jet engines; Mg casting, 40 lb.

Missile rudder, 6¼ lb Mg alloy, cast by green sand mold process.

Ninety per cent of missiles under development or in production contain Howard Foundry castings.

both core and synthetic sand systems are under laboratory supervision. Only their production assignments are given by the core or foundry foremen.

After shakeout, castings go to the stamping areas. Melt numbers from the tags are either transferred to castings by direct impression stamp or by the wiring of a duplicate impression stamped tag to castings, as the specifications may require. The latter method usually indicates that only rubber stamping is permissible on the finished part. Stampers duties also include the painting of each and every gate, sprue or riser in accordance with the color code assigned to the alloy. This precaution guarantees accurate identity of all in-plant scrap.

X-Ray

At this point an inspector selects a representative group of castings from each melt for foundry control x-ray. Wherever possible these are castings poured from the first, middle and last portion of a melt. Samples are submitted to the cleaning room for the removal of gates, sprues, risers and for rough grinding.

This procedure aids in detection of innocent or unauthorized changes of procedure in connection with any phase of production. If any control casting should reveal a localized or repetitious defect, castings from the entire melt are routed through x-ray for a complete inspection.

The value of such control is apparent because defective material is spotted soon enough to avoid unnecessary finishing. To expedite x-ray processing, a schedule board lists part number, number of samples submitted, melt number, date and time of day delivered. This information is applied to the board by the inspector who brings the castings to the department. Work is completed as detailed on technique Form No. 6 and reported on Form No. 7 (Fig. 5). The particular foreman concerned is immediately notified regarding the condition of parts.

The board pertains only to foundry control castings while the table arrangement divides all other castings in the order required by production schedules. This latter group represents parts to be subjected to radiographic examination in accordance with individual customer order specifications. They are submitted to x-ray after all foundry processing has been completed. All foundry control x-ray film is retained for a period of 18 to 24 months for reference.

The large castings being viewed by inspectors in Fig. 7 are subjected to 100 per cent radiographic inspection and must not reveal a single defect in excess of 0.100 in. diameter or over 0.2 per cent porosity in any one square inch of the entire machined surface. In this case it represents the complete face directly opposite the side which is visible.

The aluminum division is equipped with three x-ray units ranging from 140 KVP to 200 KVP and one portable fluoroscope.

The dye-penetrant inspection department functions separately but correlates its findings with those of x-ray. Figure 8 is a view of work being inspected.

Heat Treatment

Form No. 8 is the last shown in Fig. 5 and is related to the heat-treatment department. Since the time cycles are long and vary widely, this department must operate 24 hours per day. This department also comes under the direct supervision of the laboratory. Care in the

handling of all treated parts is immediately reflected in the dimensional and mechanical qualities obtained.

The form is used to identify all castings of a specific load with particular reference to alloy, date, furnace number, time at temperature, part numbers, pieces and test bars. In addition, each operator must sign his work sheet and include the Brinell hardness number average of each load which is removed from the furnaces.

The heat treating department has eleven cyclone type electric furnaces with individual control panels for each unit.

All test bars are delivered to the mechanical testing laboratory and their values determined on either 20,000 lb. or 60,000 lb. capacity universal type tensile testing machines.

Sample preparation for all types of test specimens with the exception of test bar machining is also conducted in this area which includes the drilling of samples for chemical analysis.

The main purposes of the wet chemical laboratory are to determine the values of minor or rare-earth elements not included in normal spectographic standards; to referee marginal spectro-determinations; and to establish secondary standards for obtaining greater accuracy in the preparation of multiple point working curves. The laboratory also runs complete analyses of all copper base alloys and serves as a means of controlling industrial chemicals used throughout the foundry.

Engineering Control

Quality aluminum castings are not the result of metallurgical control alone for it is equally important that they conform to all dimensional conditions specified on the engineering drawings. This portion of control belongs to the engineering department. In Fig. 2 the functions of engineering were not extended, but among their many categories are the control and maintenance of all pattern equipment and core boxes; the design and construction of templates, locating, checking and straightening fixtures; and the supervision of both the visual and layout inspection departments. They also afford direct supervision during the production of first samples made from new or revised equipment and remain with these assignments until such time as complete approval of the part has been accomplished. Production then follows.

Figure 9 shows a group of targeting fixtures used to spot face the locating points of complex castings before their subsequent machining by the customer.

Figure 10 indicates that in the production of quality castings, the layout of a small casting is of equal importance to that of a large one.

An electronic device, designed by a customer for the layout of a specific part is calibrated on the basis of a standard casting having near nominal values. It is capable of recording on a strip chart 250 points of an unknown casting within approximately five minutes. The strip chart thus produced records all plus or minus values over the entire contoured surfaces and results in the saving of about one week's time per casting. In this particular instance, each part shipped is accompanied by its corresponding layout chart.

Castings For Outer Space

Producers, both here and abroad, have made many advancements in recent years with respect to the development of superior aluminum casting alloys and yet the industry in general demands more. Today, however, we face the pioneering of outer space and this fact alone demands a new look at aluminum alloys. It is necessary to approach the subject with open mind since we all have much to learn regarding the composition-property relationships which can and will extend the use of quality aluminum castings. This can only mean further development of the potentials already at our disposal and the full co-operation of all concerned, foundries included.

As a result of recent alloy investigations, the release of a composition having unusual elevated temperature properties in combination with improved conditions at room temperature is anticipated in the near future. Such an alloy is well into its late stages of confirmation.

■ This article is based on a talk presented at the Missouri Valley Regional Foundry Conference, Sept. 27, 1957.

1958 Transactions Preview

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WRITTEN DISCUSSION IS SOLICITED

A LITERATURE REVIEW OF METAL PENETRATION*

By
A. E. Murton** and S. L. Gertsman***

INTRODUCTION

Penetration of metal into foundry molds and cores has long been a persistent source of trouble in the cleaning room. The problem has been studied by a number of investigators, and much is now known about the method of its occurrence, but no sure method of prevention has been found.

Although most of the reports of investigations were published before 1953, the interest in the problem has continued. Before further work is attempted it was felt that a thorough review should be made of the research already carried out in this field.

SUMMARY OF LITERATURE

In the earliest theories of metal penetration it was proposed that the metal penetrated as an oxide which was subsequently reduced.[1, 2] This theory and the theory that it penetrates as a gas[3] are both refuted by the fact that the penetrating metal does not differ substantially from that of the casting.[4] Such differences as do occur can be explained by segregation during solidification, or by oxidation of the metal after penetration.

In an early investigation of the problem Caine[5] used a test casting in which standard 2-in. AFS test specimens were subjected to a metal head of 7 or 8 in. (The paper does not give the exact height of casting plus riser.) The design is shown in Fig. 1.

Pouring temperatures were between 2980 F (1638 C) and 3060 F (1682 C). Increased pouring temperature of the test casting increased penetration. This effect was also observed in a production casting.

Additions of more than 25 per cent silica flour, and of bentonite and fire clay in the amounts used in foundry practice were beneficial. However, additions of less than 25 per cent silica flour or large amounts of bentonite and fire clay were detrimental. Coarse sands and low softening point sands were

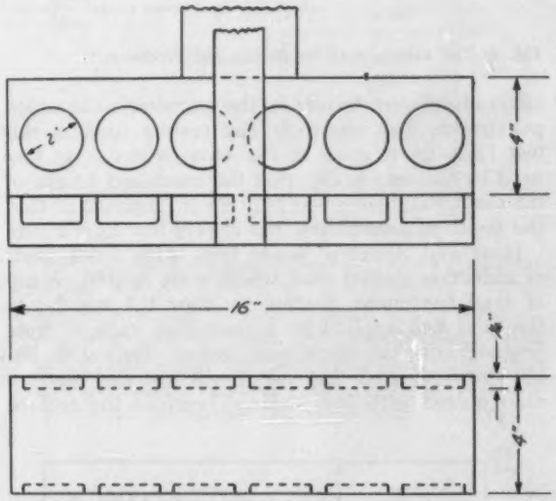

Fig. 1—Test casting used by Caine.[5]

penetrated badly. Caine interpreted these results to mean that penetration is prevented by a fused skin on the surface of the mold, but that it is promoted if large voids are present or are formed by fusion of the sand.

Cereal and core oil helped to prevent penetration, as did an addition of fused salt. Caine suggested that the results with organic binders could be explained either by the formation of over-reduced steel by reducing mold gases or by back pressure of mold gases. A tentative explanation of improved results with the salt was that they were caused by the gas pressure of the salt.

Caine concluded from his work that the major cause of penetration is mechanical entry of the metal into voids which are too large. These voids may be caused by too coarse sand, by soft ramming, or by fusion of the sand. These conclusions still seem valid; however, the low metal head of the casting gave an over-optimistic impression of the results which could be obtained by controlling void size and pouring temperature.

In an investigation of the problem Beeley and Protheroe[6] concluded that penetration can occur only above a lower limit of temperature. They studied the

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***Chief, Physical Metallurgy Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Ontario, Canada.

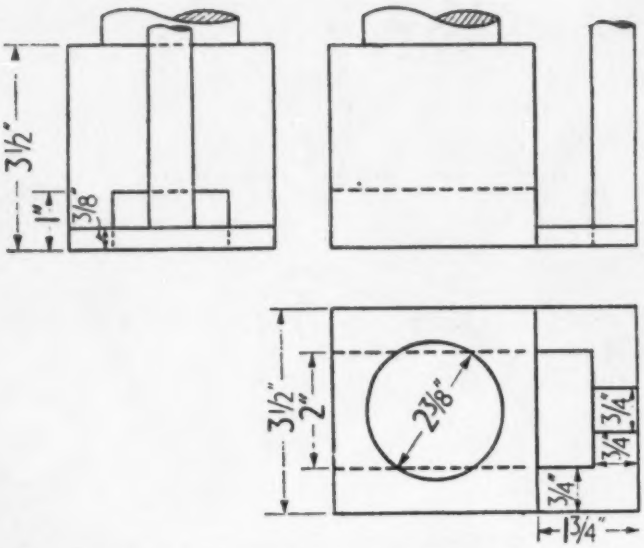

Fig. 2—Test casting used by Beeley and Protheroe.[6]

effect of different factors on the temperature at which penetration first occurred. The casting used in this test (Fig. 2) is open to the same criticism as that used by Caine, namely, that the combined height of the casting and riser was only 6½ in. Because of this, the depth of penetration was always less than 2 mm.

Hoar and Atterton[7] made tests with small heats of induction melted steel which were melted on top of sand specimens. Suction to draw the metal into the sand was applied by a controlled vacuum from beneath after the metal was melted. Tests with liquid drops showed that metal will not wet sand or sand coated with iron oxide. Therefore the surface tension of the metal acts to prevent the metal from entering the sand, and a positive pressure is always required to produce penetration.

By calculating the effect of metal viscosity, Hoar and Atterton showed that initial penetration occurs almost instantaneously. They assumed that further penetration takes place by remelting of the probes, and is limited by heat transfer.

They found that for metals with known surface tension the pressure required to initiate penetration was proportional to the surface tension (Fig. 3). For tin the penetrating pressure decreased with increasing temperature up to 1620 C (2948 F) (Fig. 4). They assumed that the decrease was due to the lower surface tension of the metal, and also to an increase in pore radius by sintering.

Above 1650 C (3002 F) there was a sudden increase in the pressure required to produce penetration. This was attributed to the formation of a continuous fused layer which prevented metal from entering the sand.

Viscous slag washes which were high in silica, formed from iron silicate or from lime-silica, prevented penetration in the authors' tests. They suggested that washes based on the principle of plugging the voids with viscous slag might work well in practice.

An extension of this work was published in 1953.[8] Measurements of the amount of penetration by iron and tin showed that both metals filled substantially all of the void space.

They found that penetrating pressure increased with

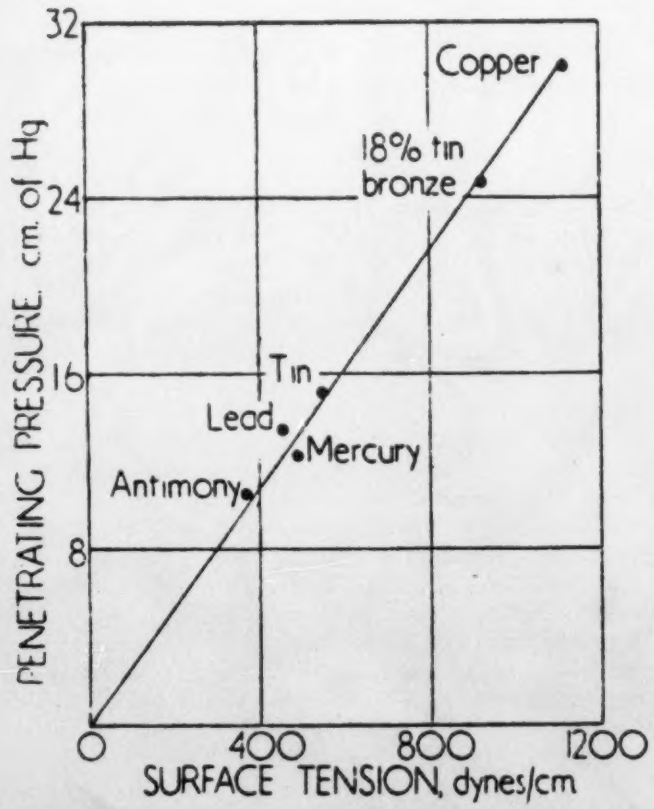

Fig. 3—Relation between penetrating pressure and surface tension of molten metal.[7]

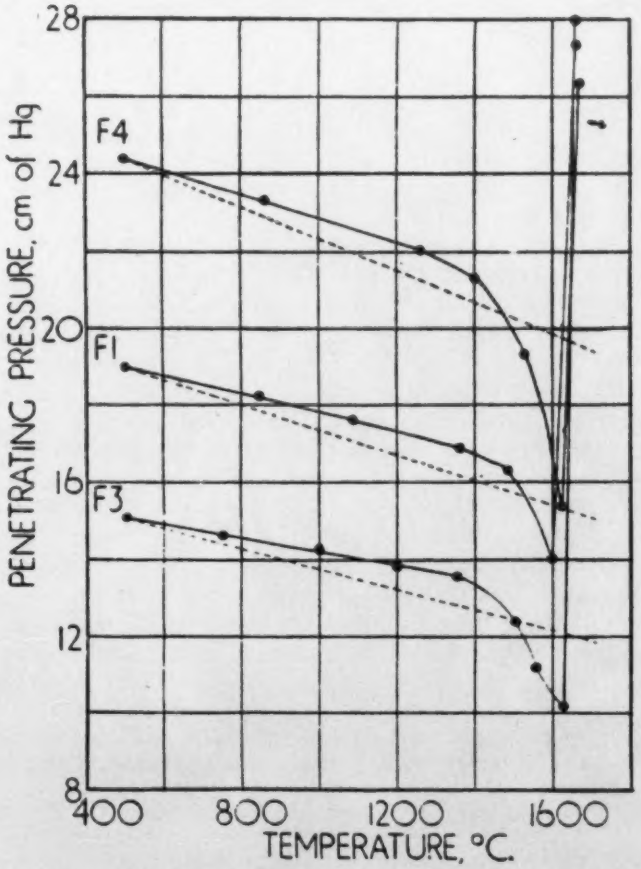

Fig. 4—Variation with temperature of penetrating pressure for tin. The dotted lines show the change which could be expected from decreased surface tension with increased temperature.[7]

increased ramming (Fig. 5). In tests with an actual casting (design shown in Fig. 6), they found a considerable variation in the amount of compaction at different points in the mold. They advocated close attention to ramming and molding sand mixtures to produce a mold as uniformly rammed as possible. The results of sintering of the sand were generally deleterious.

Gertsman and Murton[9, 10] obtained pressure to produce penetration in steel by using a casting, the height of which could be varied (Fig. 7). They found that:

a) Increasing the metal head without increasing the volume of metal passing the core increased penetration. Cores in a casting with a 5-in. head were not penetrated. Penetration was produced in the same casting with a higher head of metal. The temperature conditions were kept constant by pouring into an offset small diameter riser after the 5-in. casting was filled (Fig. 8). The amount of penetration obtained with this casting was less than that obtained with a full diameter casting of equal height. This could be explained by the shorter time during which metallostatic pressure was applied (earlier freezing of the riser), and also to heating of the cores by a smaller volume of metal.
b) There was no penetration when 450 lb of metal (comparable to 50-in. height) was passed by the cores in a 5-in. high casting.
c) Increased temperatures and pressures both caused increased penetration. Within the ranges used in foundry practice pressure was the more important factor.
d) For each height of casting there was a temperature below which further reduction of temperature (using practicable temperatures) had little effect on penetration. Increasing the temperature above this point increased the penetration noticeably.

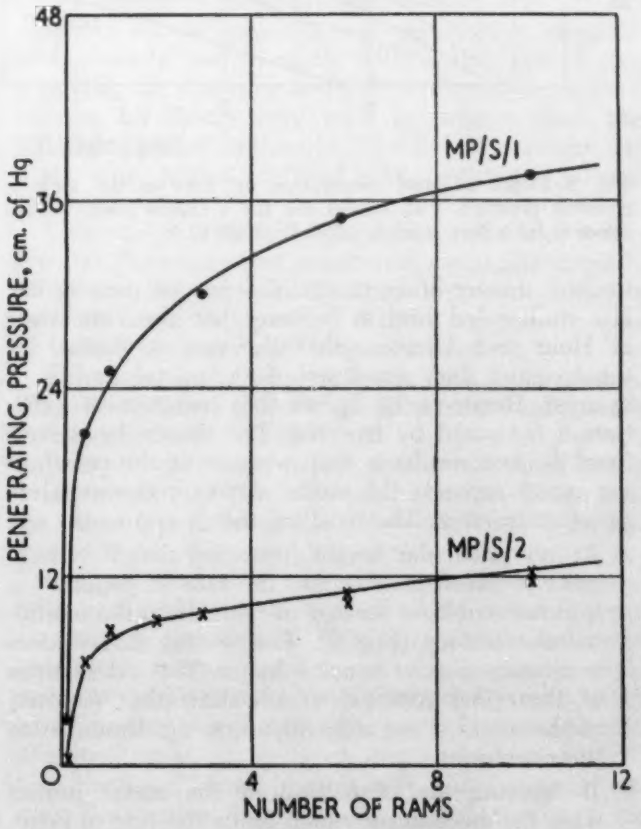

Fig. 5—Influence of degree of ramming on the penetrating pressure for tin at 650 C (1202 F). MP/S/1 and MP/S/2 are fine and coarse sands respectively.[8]

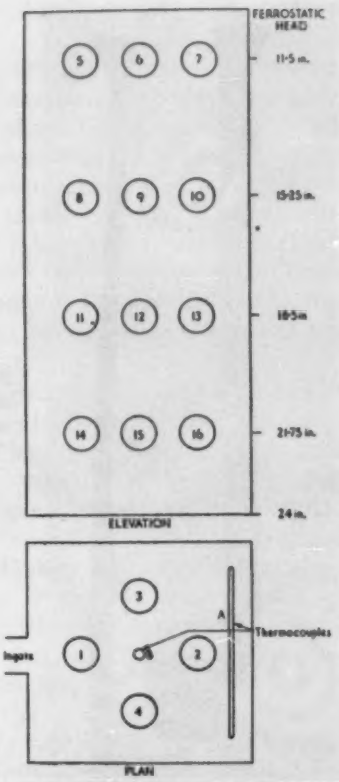

Fig. 6—Test casting used by Hoar, Atterton and Houseman showing location of test sand specimens.[8]

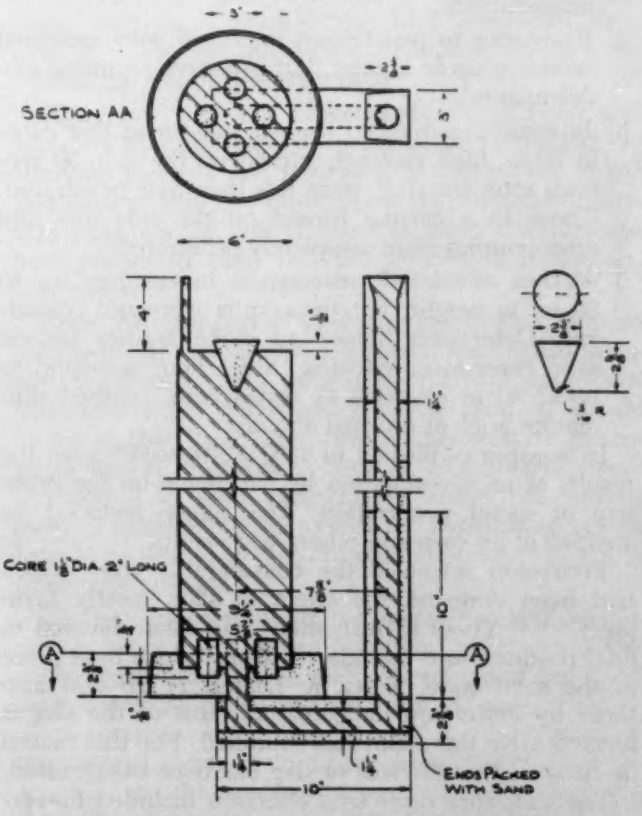

Fig. 7—Test casting used by Gertsman and Murton.[11]

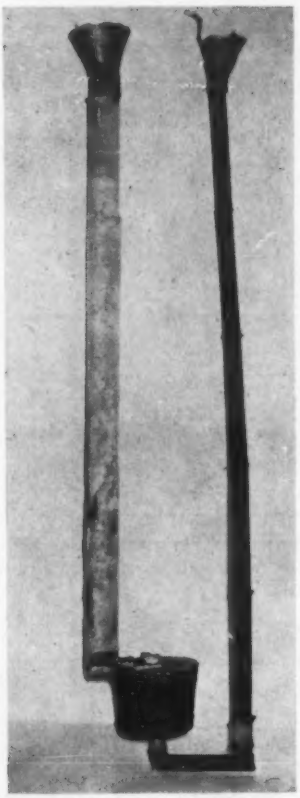

Fig. 8—Test used to demonstrate the effect of metal head on penetration.[9]

The higher castings required lower pouring temperatures.

e) Green sand cores were more resistant to penetration than unwashed oil sand or dry sand cores.

f) At high pouring temperatures a film of slag was formed on the sand surface next to the casting. Despite this, there was more penetration at higher temperatures.

g) Resistance to penetration increased with increased ramming up to a point, but excessive ramming was detrimental.

h) In some unpublished work it was found that cores in 30-in. high castings, turned on the side 30 seconds after pouring, were less than half penetrated. Those in a casting turned on the side one min after pouring were completely penetrated.

i) Washes alleviated penetration in castings up to 30 in. in height, but the results were not consistent. Detergents helped to make washes for oil sand cores more effective. Silica flour appeared to be about as effective as zircon flour, crushed sillimanite brick or crushed alumina.

In a paper published in 1951 Pettersson[12] gave the results of an investigation he had made on the problem of metal penetration. This paper included an analysis of his own and others' test results.

Pettersson reviewed the considerable work which had been done on the effect of slag, mostly fayalite.[2, 4, 5, 13] These investigations had been devoted to final products and include reactions which took place in the solid state. Tests by Dietert et al[2] and also those by Pettersson indicate that most of the slag is formed after the metal has solidified. For this reason he believes that the role of slag has been exaggerated.

The test work done by Pettersson included immersion of sand specimens in an induction heated melt of steel, and also pouring of steel castings. The test results of the two methods were not closely correlated, as the castings were penetrated more than would be predicted from the results of the immersion tests. This appears to be anomalous because one would expect the results of the immersion tests to be the more severe.

The induction furnace is in effect an unlimited source of heat whereas in the casting the heat supply is limited to the heat content of the metal poured. Pettersson attributed the more severe results of the casting tests to the fact that slag particles from the melt reacted with the sand in the immersion tests; probably the slag plugged the pores in the sand.

In fine sands and sands with a wide screen distribution a coarse and sparse type of penetration occurred. This behavior limits the effectiveness of these sands.

In contrast to other workers, who measured the critical temperature[6] or critical pressure[7, 8] to cause penetration, or the total depth obtained,[9, 10] Pettersson

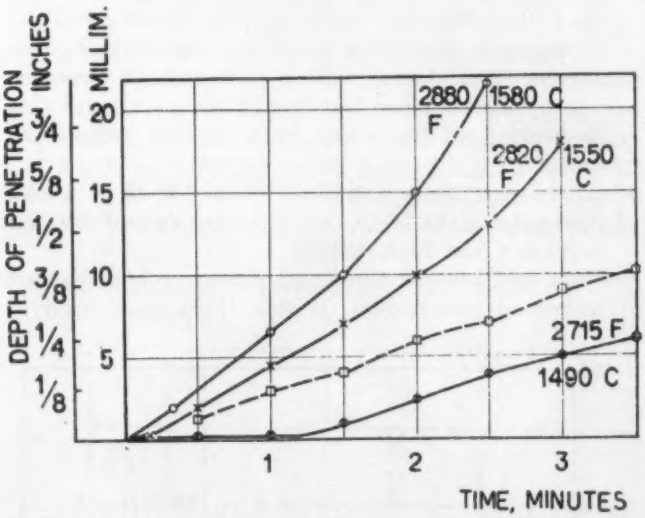

Fig. 9—Depth of steel penetration vs. time in the melt at constant pressure. Full curves are for a coarse sand. Broken curve is for a fine sand at 1550 C (2820 F).[12]

studied, among other things, the *rate* of penetration. His studies led him to believe that the conclusion of Hoar and Atterton, that the rate is limited by the freezing and remelting of the metal probes, is in error. However, he agrees that cessation of penetration is caused by freezing. The theory he derives from the test results is that pressure of the penetrating metal expands the voids, allowing the metal to penetrate further. The most important arguments are:

a) At any particular height (provided that it is sufficient to cause penetration) the rate of penetration is almost constant for any distance from the mould-metal interface (Fig. 9). This means that viscous resistance to flow is not a factor. The calculations of Hoar and Atterton which show that viscosity of the metal is not a factor are in agreement with this conclusion.

b) If freezing and remelting of the metal probes were the mechanism which limits the rate of penetration, the rate of heat transfer would be the critical factor, as pointed out by Hoar and Atterton. Therefore, increased pressure above the critical

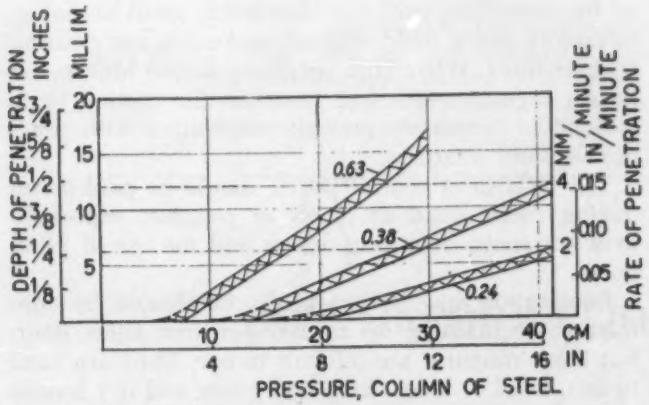

Fig. 10—Relation between depth (rate) of penetration and the pressure of the melt on the sand at 1550 C (2822 F), 3-min immersion. The figures on the curves give average grain size (mm).[12]

pressure should have no effect, because pressure does not directly affect the rate of heat transfer. However, high static pressure (caused either by metal head or gassy metal) does increase the rate of penetration (Fig. 10). Therefore, some other mechanism, dependent upon both pressure and temperature, must limit the rate.

c) High metal temperature and preheating of coarse sand by immersion caused the cores to be penetrated almost instantaneously. (Preheating of fine sands formed a glaze which prevented penetration when the pressure was applied.) The theory accounts for an increased rate in the coarse sand, because heating of the sand would soften it and help the metal to expand the voids.

Except for the sparse type of penetration observed in fine sands, and in sands with a wide screen distribution, the evidence in Pettersson's paper does not support his theory very well. In coarser sands the metal penetrated uniformly. The theory does not explain why preheated sand was penetrated almost instantaneously.

This work corroborates the findings of Hoar, Atterton and Houseman that penetrated metal fills virtually all of the void space in the sand. Pettersson suggests that this could be explained if there were an increase of wetting tendency with time of contact.

The paper includes some work with mold washes. They were found to be helpful, but the results were not consistent.

It has been shown that a purely mechanical type of penetration occurs in foundry practice. There may be other types, but only the mechanical type has been proved.

Because steel does not wet sand or sand coated with iron oxide, surface tension of the metal opposes mechanical penetration. This means that small void size, high surface tension, and high contact angle act to prevent the metal from entering the sand. High metal pressures and high temperatures promote penetration.

It has been shown that fayalite slags at time prevent penetration. However, the fact that most of the slag is formed after the steel solidifies appears to justify the conclusion that it is not an important factor. This view would have to be revised if it could be shown that slag has a significant effect on surface tension.

Sintering of the sand is usually detrimental because it enlarges the voids. However, the formation of a fused layer at the sand surface has at times prevented penetration.[7, 12, 18] It appears that for this to hapepn the fused layer must be continuous, and be formed before the pressure of the metal can act. It should be noted that, except under laboratory conditions, effective glazes have not been reported to have been formed by increasing pouring temperatures. On the contrary increased pouring temperatures have a detrimental effect.

It has been shown that penetration can occur rather slowly. The mechanism which limits the *rate* and depth of penetration is of interest. Hoar, Atterton, and Houseman consider the limitation to be by freezing of the probes of penetrating metal, which must be subsequently remelted for penetration to proceed further. This would make the rate dependent upon the rate of heat transfer. Pettersson points out that on this basis the effect of pressure is hard to explain, because pressure would not affect any of the constants which determine heat transfer.

It can be argued that the direct effect of increased pressure is to increase the depth of penetration. However, the longer probes would require longer periods of time to be remelted. The net effect of these two factors would at most be a slight increase in the rate of penetration.

A mechanism by which pressure could affect the rate of heat transfer may be explained by taking into consideration the different heat conductivities of metal, sand, and voids. Increased pressure increases the number of passages by which penetration can occur. This speeds up the rate of heat transfer because metal is a much better heat conductor than sand or voids. By this means increased pressure increases the rate of penetration.

This theory explains how the theory of Hoar and Atterton that the rate of penetration is limited by alternate freezing and remelting of the probes is not inconsistent with the observation that increased pressure increases the rate of penetration. It also explains how preheated sand can be penetrated almost instantaneously.

Hoar, Atterton, and Houseman found that increasing the metal temperature decreased the critical penetrating pressure. They attributed this to lowered surface tension and to sintering of the sand. It should be noted that if, at any pressure, penetration cannot begin unless the surface tension has been lowered by heating to some temperature above the melting point, it cannot continue unless the penetrating probes have been heated to that critical temperature at which penetration began.

Under these conditions the metal tips will be liquid. In other cases pressure may be great enough to cause penetration at the melting point, and the metal probes will be partially frozen. In all cases the rate of penetration will be governed by the ability of the thermal conductivity of the metal and the thermal reservoir in the casting to maintain the probes at the critical temperature and to reheat advancing

probes which have been chilled below the critical temperature.

As noted above, Pettersson has shown evidence that enlargement of voids under pressure is a factor when the void size is small. The passages for penetration may be so restricted that the progress of the metal will be blocked until they are enlarged by pressure or fusion of the sand. In such cases, at any temperature, some of the factors determining the rate of penetration would be the surface tension of the metal and the hot strength and deformation of the sand.

Enlargement of the voids by pressure and fusion would especially be the case with fine sands and sands with wide screen distribution, but these factors might also act between the penetrating probes of metal in more open sands. The fact that virtually all of the voids have been filled by metal is an indication that this mechanism is indeed operative.

It appears from the above that void size, pressure and temperature operate together to control the rate of penetration. Void size will determine how great the pressure to penetrate must be at any surface tension. Pressure overcomes the influence of surface tension, increases the heat conductivity of the sand-metal compact by supplying more penetrating probes, and may enlarge the void size. Temperature decreases surface tension, helps to enlarge voids by fusing the sand, and increases the heat flow to the penetrating probes.

It has been shown that penetration by liquid metal will occur when the pressure is great enough to overcome surface tension effects. After the almost initial instantaneous penetration the rate of further penetration is postulated to be limited either by alternate freezing and melting or by the increased surface tension of the continuously cooling metal. The particular conditions govern which of these mechanisms will operate.

On the basis of the above theory the apparently contradictory results obtained by investigators with carbon steel could be explained. Hoar and Atterton found that critical pressure, and Beeley and Protheroe that critical temperature, were lowered by increased carbon content of the steel. From these results it could be predicted that, at any given temperature and pressure, increased carbon content would increase the rate of penetration. However, Pettersson found that increased carbon content lowered the rate of penetration. The lowering of critical pressure and critical temperature are probably explained by lowered surface tension and contact angle, or by the width of the solidification range.

The lowering of the rate of penetration could be caused by decarburization of the surface of the penetrating probes which would raise their freezing point. According to these results, high carbon content steel could be expected to be more subject to "burn-on" than low carbon steel, but there would be less likelihood of experiencing deep penetration.

The foundryman will want to know what he can learn from the above discussion which will help him to eliminate penetration. Unfortunately, the answer is that there is not much in this review that is inconsistent with good foundry pracice. With low metal heads mechanical penetration can be eliminated by controlling void size (fine sands, good ramming, refractory sands, mold washes), and using low pouring temperatures. When it is necessary to use high metal heads, together with hot spots on the casting, it is difficult at present to prevent penetration with practicable sand mixtures.

The tests show that attention should be paid to reducing metal head as much as possible, especially over hot spots, by gating design and the use of blind risers.

Penetration may be practically eliminated by core mixtures containing up to 100 per cent silica flour, but these mixtures are difficult to use. They are hard to mix, hard to bake, have low green and dry tensile strength, and their use is likely to result in other casting defects.

Some alleviation might be obtained by cooling the core. In some unpublished work it was found that a brass tube inserted into the core reduced penetration considerably by conducting heat away from the center. Similarly chills, to be incorporated into the casting, could be used on the outside of the core to eliminate hot spots.

The results obtained by Hoar and Atterton and by Pettersson with sands preheated by molten metal suggest that penetration in fine sands might be decreased by interrupted or slow pouring of large castings, to allow a glaze to form on the sand at low pressures. However, this would be hard to do without freezing the gating system.

It is unfortunate that with all of the work done on the mechanism of metal penetration the absolute remedy still eludes us.

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WRITTEN DISCUSSION IS SOLICITED

HOT DEFORMATION OF MOLDING SAND

By

Harry W. Dietert* and Tom E. Barlow**

INTRODUCTION

Molding sand at elevated temperatures above 500 F is not a rigid body (which does not deform or move when a load is applied). When a compressive load is applied to a rammed molding sand specimen that is heated, the sand specimen will shorten even though the sand is dry and hot. Thus the heated wall of a mold will possess a degree of deformation or inter-sand-grain movement when an external load is applied, or when an internal stress results from sand expansion.

External load is mainly from the thermal-static pressure head of molten metal. The internal loading is due to the growth of the sand grains from thermal expansion. The internal loading is sufficient to rupture the mold face providing the hot deformation of the sand will not accommodate the movement caused by the expansion. In silica sand it can be assumed that the expansion forces are always present in sufficient magnitude to rupture the mold wall if insufficient hot deformation is possessed by the sand to absorb the expansion.

The AFS Committee 8-J and 8-L reports, scheduled for publication in AFS TRANSACTIONS, 1958, show restraining load test data. The load in this test is created by the internal loads caused by expansion stresses that are not accommodated by hot deformation. Restraining loads over 10 psi, in case of gray iron sands, cause rupture on mold face. In the case of steel castings sands, a restraining load over 50 psi caused scab losses due to mold wall fracture. In most instances the test castings and actual production experience do correlate. This is to be expected, for geometry and size enter into any relation involving movement. Therefore, no hard and fast correlation can be made between the test specimen and a mold surface differing in both geometry and size.

One can escape this condition by providing cushioning materials to increase hot deformation or by nailing or venting. This procedure carries the heat into a large mass of the mold and avoids excessive heating of thin layers on face of mold.

The importance of having information on hot deformation property of molding sand is vital in the production of quality castings. Heretofore, insufficient knowledge existed on a method for expressing the hot deformation in a practical manner.

Hot Deformation Expression

Previously the hot deformation test was expressed as the total hot deformation at rupture load. This is the ultimate deformation and is much beyond any safe workable point of a sand.

A possible improved manner of expressing hot deformation involves the use of a factor that expresses deformation rate per psi. The hot deformation rate factor may be computed by formula:

$$\text{Hot Deformation Rate} = \frac{1000 \times \text{Hot Deformation at Chosen Load}}{\text{Chosen Load}}$$

The chosen load is any compressive hot strength reading less than one-half of the rupture load.

For example: Select 50 psi hot compressive load as the chosen load. The hot deformation at 50 psi read 0.020 on the hot deformation recorder. Thus–

$$\text{Hot Deformation Rate} = \frac{1000 \times 0.020}{50} = 0.40$$

The object of multiplying by 1000 is to secure a reasonably large fraction or whole number. The larger the hot deformation rate factor the safer the sand is from a possible mold wall fracture slope.

The hot deformation rate factor also expresses the angle of the stress-strain diagram. The greater the slope from the ordinate (hot strength) the greater the hot deformation rate factor.

In addition to the ultimate hot deformation and hot deformation rate, one should be aware that molding sand also has hot toughness. Hot toughness is computed by formula:

$$\text{Hot toughness} = 1000 \times \text{Ultimate Hot Deformation} \times \text{Rupture Load}$$

The larger the casting the greater should be the hot toughness of the sand. Sand mixes used for large castings of steel should contain silica flour or a blend of western bentonite and fire clay. Sands bonded with fire clay are also adaptable for the heavier type castings. These sand mixes possess a high hot toughness, illustrating that a high hot toughness is a desir-

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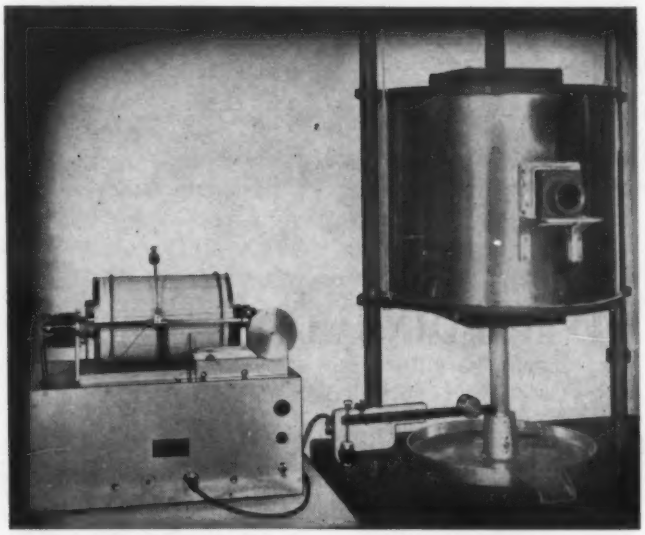

Fig. 1—Hot deformation recorder used for recording hot deformation and hot strength.

able attribute for sands used for heavy castings. The term "hot toughness" is a general one to denote hot properties involving sintering and thermal stability imparted by additions such as silica flour, bentonite, fire clay and combinations of these additions. One possible method of measuring these illusive properties is described in the following paragraphs.

Equipment

Two types of equipment are available to measure the hot deformation of a sand:

1) A hot deformation recorder (Fig. 1) which automatically records both the hot strength and hot deformation. The graph secured is a stress-strain diagram as illustrated in Fig. 3.

2) A hot deformation indicator accessory (Fig. 2) which can be set to indicate either the ultimate hot deformation or hot deformation at a predetermined load. From the latter reading the hot deformation rate can be computed.

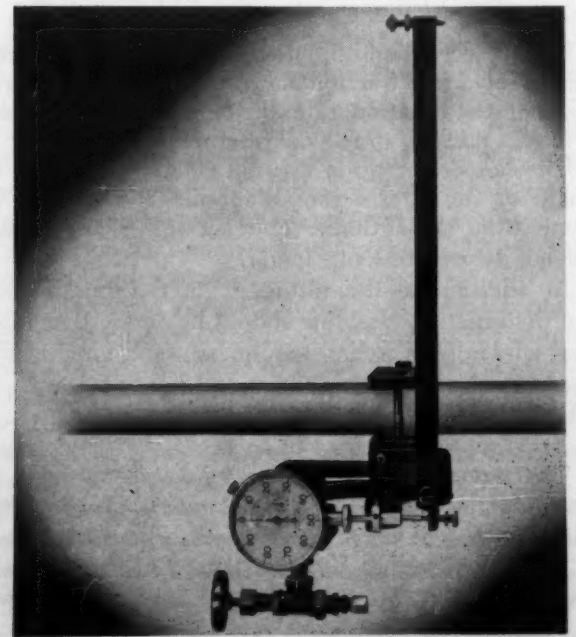

Fig. 2—Hot deformation indicator accessory for dilatometer.

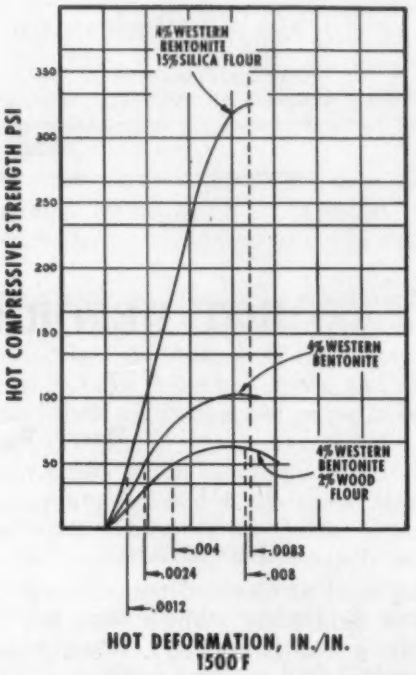

Fig. 3—Stress-strain diagrams for bentonite bonded sands without additive, with 2% wood flour and 15% silica flour.

Hot Deformation Rates vs. Ultimate Hot Deformation

The ultimate hot deformation of certain sands may be identical for all practical purposes, while they may be quite different in the rate at which deformation takes place.

For an illustration of this fact, note the stress-strain diagrams in Fig. 3 at 1500 F temperature. The ultimate hot deformation for the 4 per cent western bentonite sand and the 4 per cent western bentonite sand plus 15 per cent silica flour are alike at 0.0083 in./in. When 2 per cent wood flour is added the ultimate hot deformation is 0.008 in./in. The ultimate hot deformation finds its use for determining the hot toughness. The hot strength of these three sands are very different, giving a wide spread in hot toughness.

The hot deformation rate, computed from deformation found at 50 psi load, Fig. 3, possibly shows why these three sands have different behavior in reference to mold fracture under certain conditions. The base sand of 4 per cent western bentonite has a hot deformation rate of 0.048. When 2 per cent wood flour is added the hot deformation rate increases to 0.080 and reduces to 0.024 when 15 per cent silica flour is added: in one case, nearly a 100 per cent increase and in the other case a 50 per cent reduction.

Temperature Affects Hot Deformation

The hot deformation of a sand increases rapidly as temperature increases. This is well illustrated in Fig. 4, where hot deformation curves show a marked increase in slope as temperature is increased from 500 F to 2500 F.

TABLE 1–THE EFFECT OF TEMPERATURE ON HOT DEFORMATION

Temperature, F	Ultimate Hot Deformation (in./in.)	Hot Deformation Rate Factor	Ultimate Hot Strength, psi
500	0.0072	0.036	85
1000	0.0098	0.050	94
1500	0.0124	0.072	318
2000	0.0454	0.180	172
2500		infinite	5.7

The data tabulated in Table No. 1 give a good numerical illustration of the marked effect of temperature on the hot deformation of sands. For example, the hot deformation rate factor shows an increase from 0.036 to 0.180 in./in. of length for a temperature change from 500 to 2000 F.

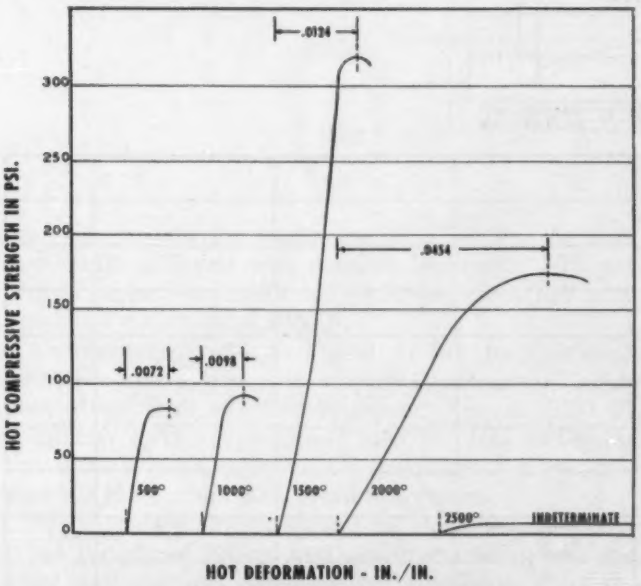

Fig. 4–Hot deformation is affected by temperature.

Moisture Affects Hot Deformation Rate

The moisture which is used to temper a sand has a marked effect on the hot deformation rate of a sand. The higher the moisture content of a sand the lower will be the hot deformation rate. Stated in other words–excess water in reference to temper causes a sand to become brittle under the conditions of these particular tests.

The stress-strain curves in Fig. 5 increase in slope as moisture increases. A study of the data tabulated in Table 2 will show the magnitude of moisture effect on hot deformation.

From the stress-strain diagrams (Fig. 5) the hot deformations at 50 psi load proved to be: 0.011, 0.021 and 0.035 in./in. for high, temper and low moisture, respectively.

TABLE 2–INCREASE OF MOISTURE REDUCES HOT DEFORMATION RATE

Moisture Range	50 psi Hot Deformation (in./in.)	Ultimate Hot Deformation (in./in.)	Hot Deformation Rate
High	0.011	0.095	0.22
Temper	0.021	0.115	0.42
Low	0.035	0.119	0.70

The ultimate hot deformations are: 0.095, 0.115 and 0.119 in./in. for high, temper and low moisture.

The hot deformation rate for the high, temper and low moisture sand is 0.22, 0.42 and 0.70. This increasing rate of accommodating deformation with decrease in moisture agrees with practice. For example lower moisture retards mold wall fracture. Consequently, scrap losses from rat tails, buckles, or expansion scabs are reduced.

The hot deformation rate factor is preferred over the hot deformation at a chosen load because it is based on a unit load and adaptable to all sands.

Hot Deformation Rate Is Affected by Additives

The hot deformation rate of a sand at elevated temperatures can be changed through the use of additives. This is shown graphically in Fig. 6 and the test data is tabulated in Table No. 3.

The hot deformation rate in the 500 to 1500 F temperature range is increased by the addition of wood flour and cereal. It is actually reduced by the addition of sea coal, pitch and silica flour in this temperature range.

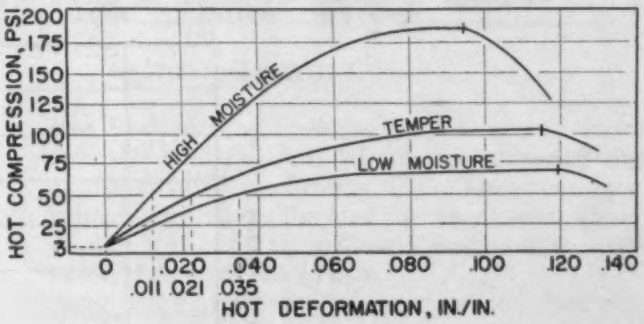

Fig. 5–Stress-strain diagrams for sands with low temper and high moisture content.

Wood flour, sea coal, pitch, and cereal greatly increase the hot deformation rate at 2000 F. Sea coal imparts the greatest increase. An addition of 15 per cent silica flour reduces the hot deformation rate to less than one-half that of the original sand without silica flour, up to 2000 F in air with no contamination of the sand. The behavior of such mixes above 2000 F and with iron oxide contamination has not been investigated. This agrees with some metal casting experience in which mold wall fracture is exaggerated by large additions of silica flour.

TABLE 3–HOT DEFORMATION RATE IS AFFECTED BY ADDITIVES

Additive	500 F Hot Deformation Rate	1000 F Hot Deformation Rate	1500 F Hot Deformation Rate	2000 F Hot Deformation Rate
No additive	0.036	0.044	0.056	0.158
15% Silica Flour	0.034	0.029	0.022	0.064
2% Wood Flour	0.078	0.078	0.086	0.226
1% Cereal	0.060	0.104	0.060	0.336
3% Pitch	0.032	0.026	0.034	0.380
5% Sea Coal	0.035	0.027	0.036	0.646

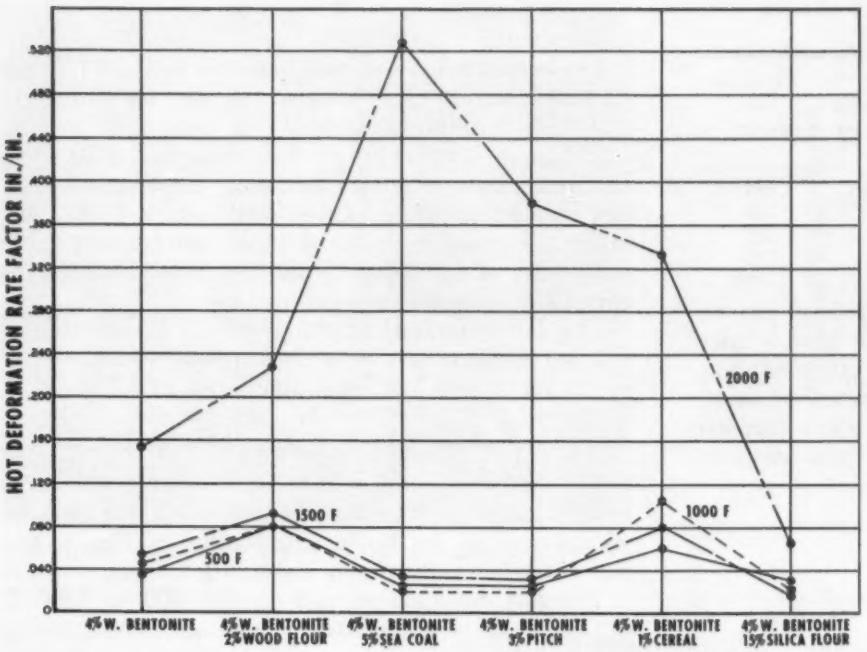
HOT DEFORMATION RATE FACTOR IN./IN.
2000 F
1500 F
1000 F
500 F
4% W. BENTONITE
4% W. BENTONITE 2% WOOD FLOUR
4% W. BENTONITE 5% SEA COAL
4% W. BENTONITE 3% PITCH
4% W. BENTONITE 1% CEREAL
4% W. BENTONITE 15% SILICA FLOUR

Fig. 6—Sand additives affect the hot deformation rate.

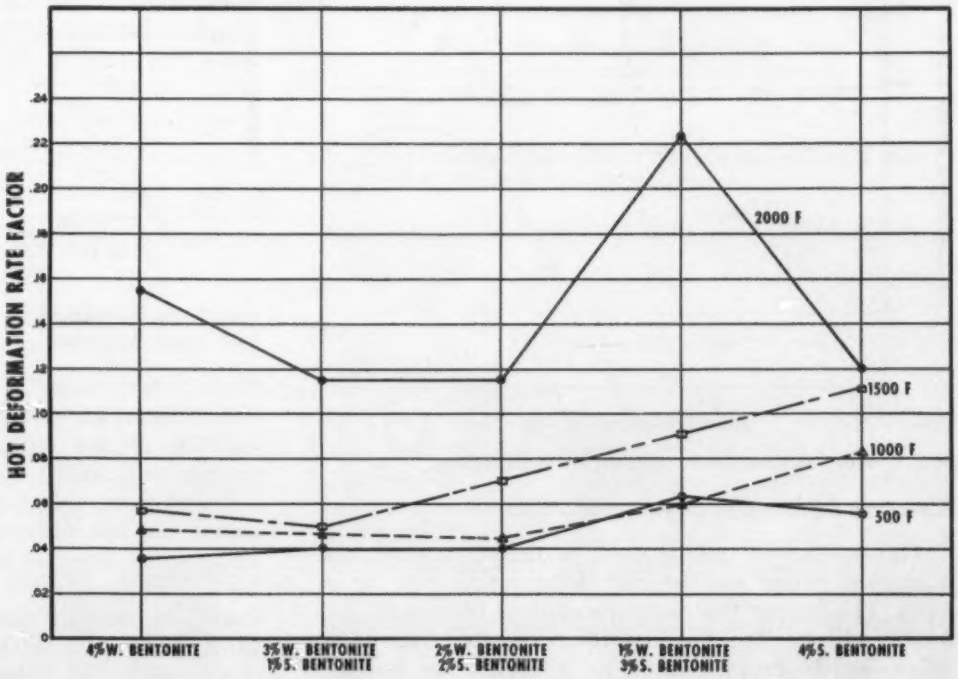

Fig. 7—Blending of bonds affects hot deformation rate.

Hot Deformation Rate Is Affected by Bentonite Blends

A fairly general practice is to blend western and southern bentonites. These blends affect the rate of hot deformation, as illustrated in Fig. 7. When the ratio of western bentonite exceeds or equals that of southern bentonite, the rate of hot deformation does not increase over that of all western bentonite. However, a blend of 1 per cent western bentonite and 3 per cent southern bentonite (Fig. 7) exhibits the greatest rate of deformation at 2000 F and 500 F.

Both AFS Committees 8-J and 8-L Reports, in 1958 AFS TRANSACTIONS, have found a test temperature of 1800 F better for correlating mold fracture scrap. Thus one can place the most emphasis on the 2000 F temperature deformation rate. Judging from hot deformation rate test data, a blend of 1 part western bentonite and 2 parts southern bentonite plus a suitable additive may well form a good mix to retard mold wall fractures, but must be proven for any given metal and operating conditions by casting tests.

Hot Toughness

The hot toughness of a molding sand at elevated temperatures is used by some investigators as a gage to sand erosion resistance. Hot toughness varies for different bonds, additives, and temperature ranges. In Fig. 8 the hot toughness of different bonds is shown at various temperatures.

The hot toughness of all bonds shown is low at 500 F and 1000 F. Some investigators consider this a danger zone in reference to reduction of dirt inclusion scrap.

The following bonds have peaks of hot toughness: 4 per cent western bentonite with 15 per cent silica

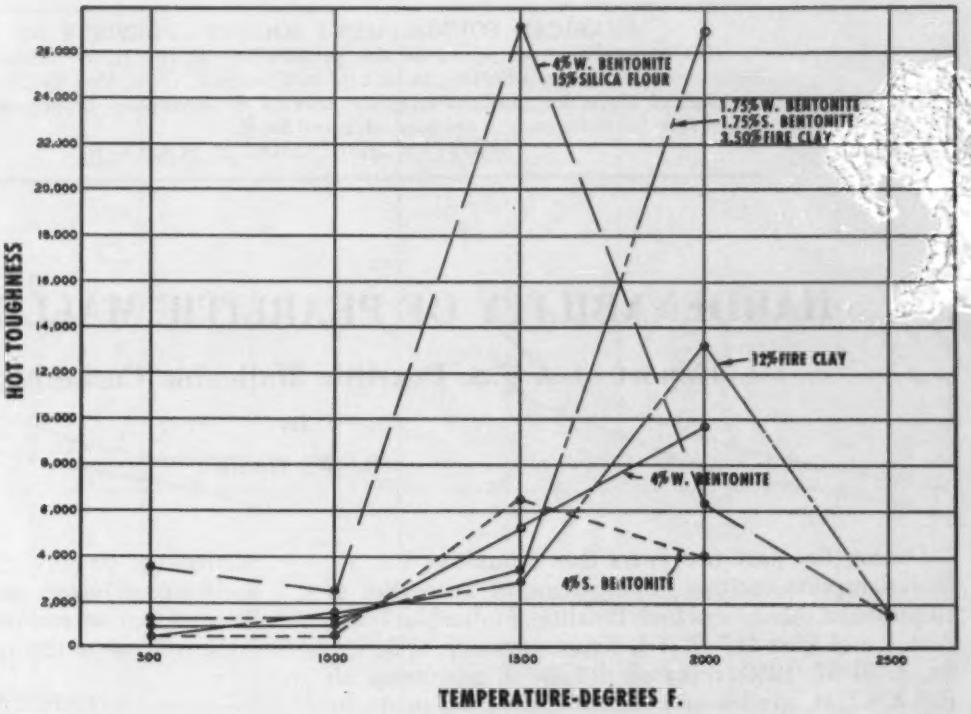

Fig. 8—Hot toughness of sands is affected by blends of bonding material.

flour has maximum toughness at 1500 F; the mix containing 1.75 per cent western bentonite, 1.75 per cent southern bentonite and 3.50 per cent fire clay reaches a maximum at 2000 F.

Southern bentonite is lowest in hot toughness at 2000 F. The 4 per cent western bentonite, 15 per cent silica flour mixture is second low at 2000 F. A mixture of this type should have fire clay to bolster the 2000 F hot toughness. Of the single binders, fire clay has the highest 2000 F hot toughness.

More research work should be done to determine what blends of bonds and additives will yield the most uniform and adequate hot toughness throughout the mold temperature range.

CONCLUSIONS

A summary of salient points from this paper may encourage foundrymen to give more thought to the important sand property—hot deformation:

1) The need for hot deformation arises because sand grains grow or expand when heated by molten metal.
2) Hot deformation is one means that a sand possesses to accommodate such expansion. Sand grain expansion places the face of a mold in a compressive load. As the load increases the sand mold face will undergo hot deformation, relieving excessive compressive loading. If the sand mold face is unable to relieve the load by deformation, grain growth will build up sufficient compressive stress to buckle the sand mold face.
3) Sand will expand at a progressive rate; thus one should measure and numerically express the accommodating hot deformation as a rate factor at relative low loads and not at rupture load.
4) The hot deformation rate factor is a possible method for evaluating sands as to their safety factor in reference to mold surface fracture tendencies.
5) Ultimate hot deformation is useful in evaluating the hot toughness of sand in reference to dirt inclusions, cuts and washes.
6) The hot deformation rate at 2000 F may be increased by the following:
   a) Addition of cellulose materials;
   b) Addition of cereal binders;
   c) Addition of sea coal;
   d) Addition of pitch;
   e) Working sand on dry side of temper;
   f) Working sands with ample clay substance;
   g) Limiting fines.

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This paper has been approved for presentation at the 62nd Annual Meeting of the American Foundrymen's Society, to be held in Cleveland, Ohio, May 19-23, 1958. The Society reserves all rights for publication either prior to or subsequent to presentation, and is not responsible for statements or opinions advanced herein.
WRITTEN DISCUSSION IS SOLICITED

HARDENABILITY OF PEARLITIC MALLEABLE IRON

Report of A.F.S. Pearlitic Malleable Committee (6E)*

by

R. W. Heine*

During the past two years this committee has authored reports entitled "Comparison of Properties of Liquid and Air Quenched Pearlitic Malleable Irons, Part I and Part II." Part I, TRANSACTIONS, AFS, vol. 64, p. 91-97, 1956, reported details of processing all the A.S.T.M. grades of pearlitic malleables made by foundries practicing duplex melting. Part II, TRANSACTIONS AFS 1957, continued this subject for foundries producing pearlitic malleables by the cold-melt melting practice and for both melting processes combined with alloying.

Heat treatments used by the foundries for producing all the A.S.T.M. pearlitic malleable grades were described in detail in these first two reports. However, heat treatments employed by the foundry are not necessarily the final heat treatment applied to the finished castings. The purchaser or user of the casting may wish to apply the final heat treatment used to develop the mechanical properties desired in the casting. Castings may be purchased in a soft condition for machining and may later be hardened. For other processing reasons, the castings may be supplied in one condition of heat treatment and heat treated after the processing is completed.

Pearlitic malleable permits this to be done, since it may be heat treated by the quench-hardening and tempering treatments that are applied to steels. Heating to a temperature of 1475 to 1600 F, holding at temperature for a suitable period of time, followed by quenching can produce full hardening as in the case of steels. After hardening, tempering at temperatures selected to produce the desired hardness and strength may be employed as is done with steels. For these treatments, it is frequently desirable for metallurgists and engineers to have available information that describes the response of the metal to hardening. Usually this information is reported in the form of Jominy end-quench hardenability curves. Presentation of end-quench hardenability curve data is the purpose of this report.

HARDENABILITY TESTS

Six foundries submitted castings for Jominy end-quench hardenability tests. The test bars were in the form of castings 1¼-in. diam. by 6 to 8 in. long, having the chemical analyses reported in Table I. As received, the castings had been heat treated by conventional methods for producing pearlitic malleable. A portion of the bars had been liquid-quenched and a portion air-quenched prior to tempering, according to the normal practice of the foundry supplying the bars as described in references 1 and 2. The castings were machined to the standard hardenability test bar size of 1.0 in. diam. by 4.0 in. long.

After machining the castings were heated to 1500 F or 1600 F, held for 30 min, and then quenched with the water spray in the standard Jominy end-quench hardenability fixture. After cooling, 0.015-in. flats were ground on opposite faces of the bars, and Rockwell hardness measurements were made at 1/16-in. intervals from the quenched end. The results are plotted in Figures 1 through 9. The figures permit the following conclusions to be stated.

1) Similar hardenability curves are produced regardless of whether liquid or air quenching is employed by the foundry as a part of the prior pearlitic malleable heat treatment.
2) Austenitizing the bars at 1600 F raises the hard-

TABLE 1–CHEMICAL COMPOSITION–HARDENABILITY TEST BARS

Plant Designation*	C	Si	Mn	P	S	Cr	Ni
A	2.45	1.44	0.53	0.02	0.151	0.024	0.065
B	2.46	1.38	0.45	0.056	0.185	0.038	
C	2.59	1.40	0.43	0.05	0.128	0.018	
F	2.40	0.97	0.74	0.115	0.093	0.02	0.03 Cu 0.50
I	2.30	1.15	0.31	0.11	0.078	tr.	
X	2.46	1.45	0.45	0.080	0.140	0.02	

*Plants A,B,C,F, and I are the ones of the same code number in references 1 and 2, previous reports of this committee. Plant X represents an additional source.

*Members of AFS Pearlitic Malleable Committee (6-E) are as follows: R. W. Heine, University of Wisconsin, Madison, Chairman; A. H. Karpicke, Saginaw Malleable Iron Plant, Central Foundry Div., General Motors Corp., Saginaw, Mich., Vice-Chairman; W. M. Albrecht, Chain-Belt Co., Milwaukee; J. E. Kruse, Albion Malleable Iron Co., Albion, Mich; J. H. Lansing, Malleable Founders' Society, Cleveland; Milton Tilley, National Malleable & Steel Castings Co., Cleveland; W. C. Truckenmiller, Albion Malleable Iron Co., Albion, Mich.; P. F. Ulmer, Link-Belt Co., Indianapolis, Ind.; and E. N. Wheeler, Belle City Malleable Iron Co., Racine, Wis.

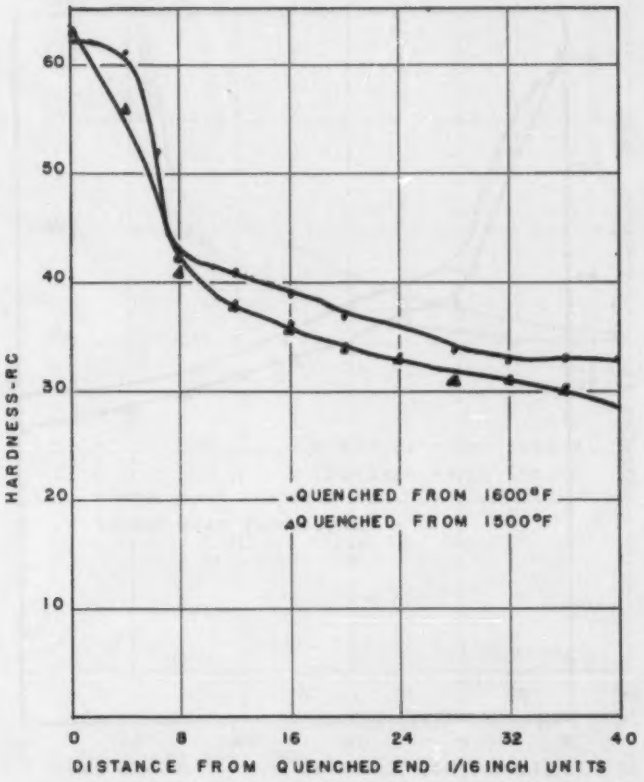

Fig. 1—Test Bar hardness, Plant A, air quench.

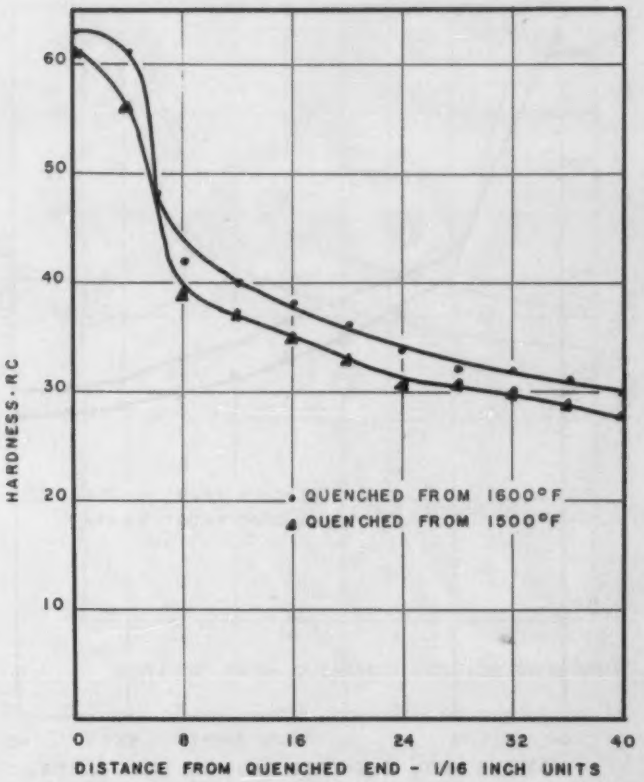

Fig. 2—Test bar hardness, Plant A, liquid quench.

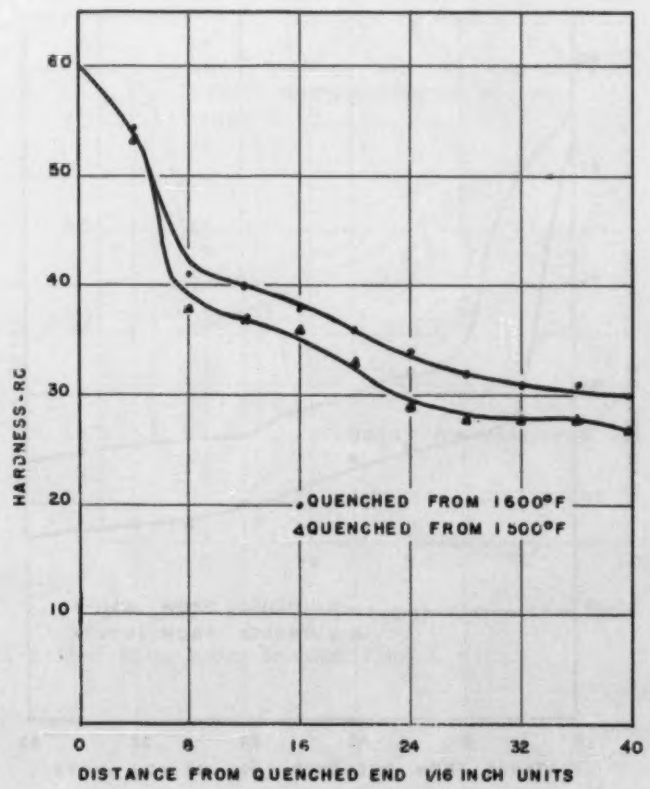

Fig. 3—Test bar hardness, Plant B, air quench.

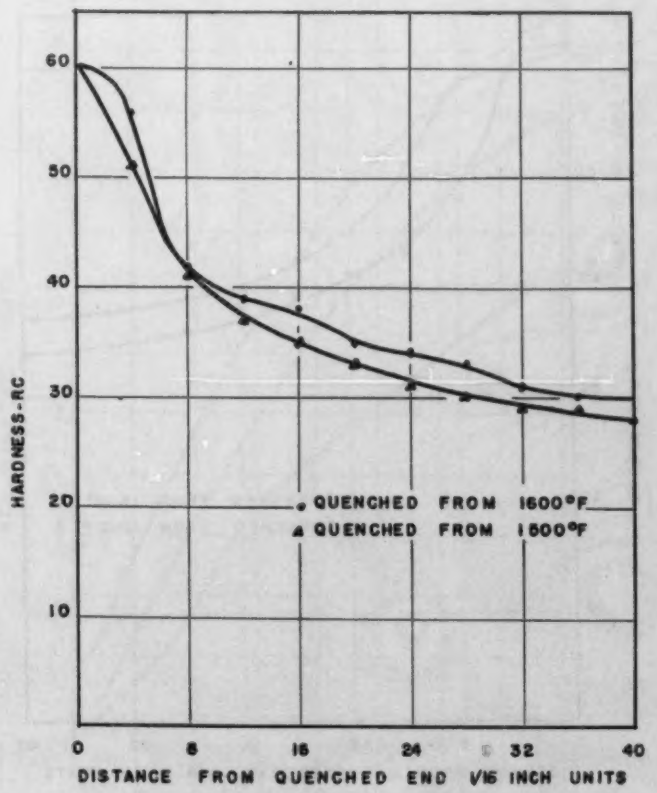

Fig. 4—Test bar hardness, Plant B, liquid quench.

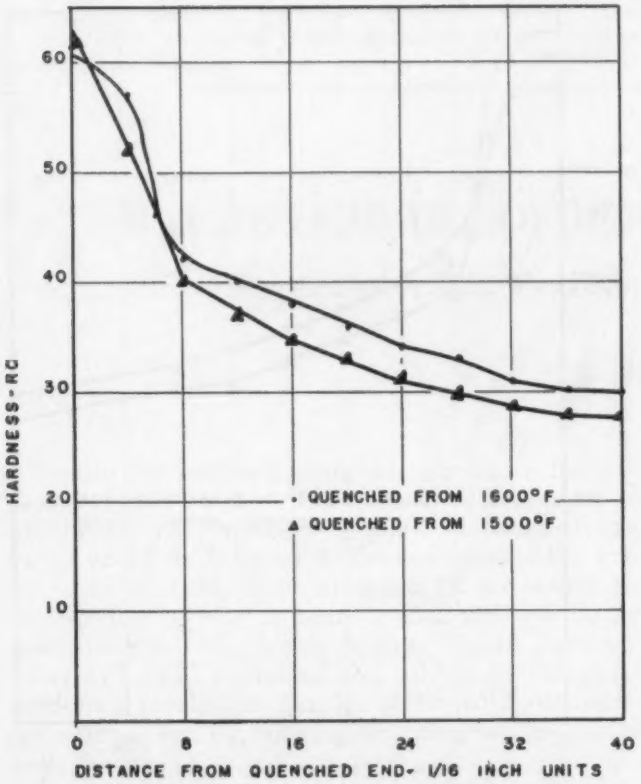

Fig. 5—Test bar hardness, Plant C, air quenched initially.

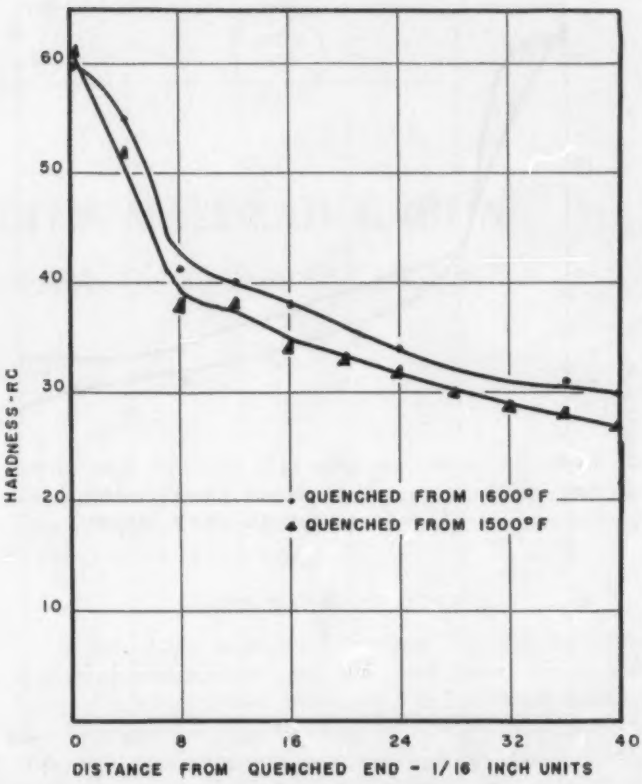

Fig. 6—Test bar hardness, Plant C, liquid quenched initially.

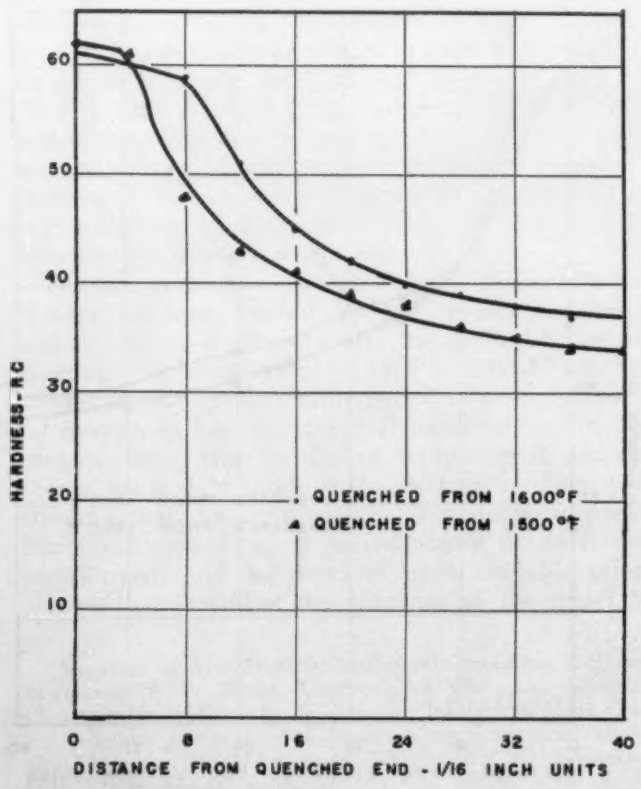

Fig. 7—Test bar hardness, Plant F.

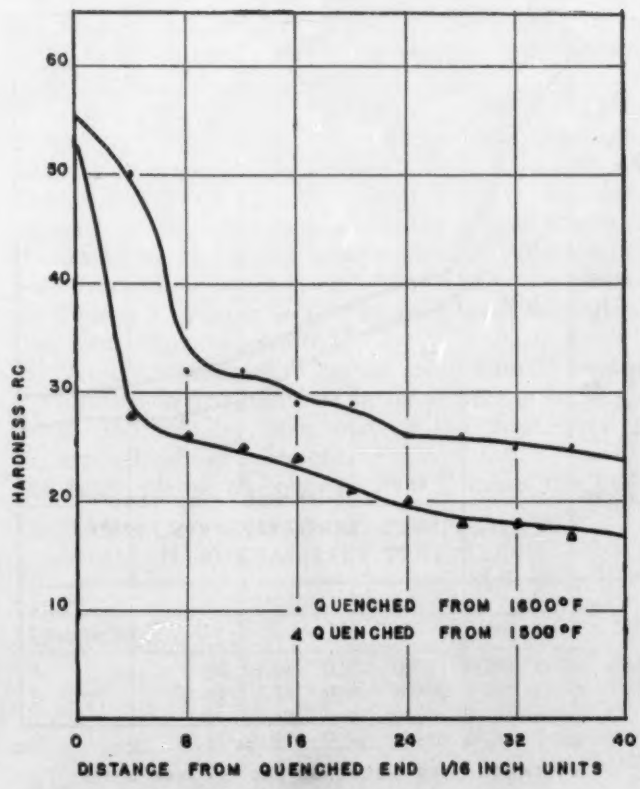

Fig. 8—Test bar hardness, Plant I.

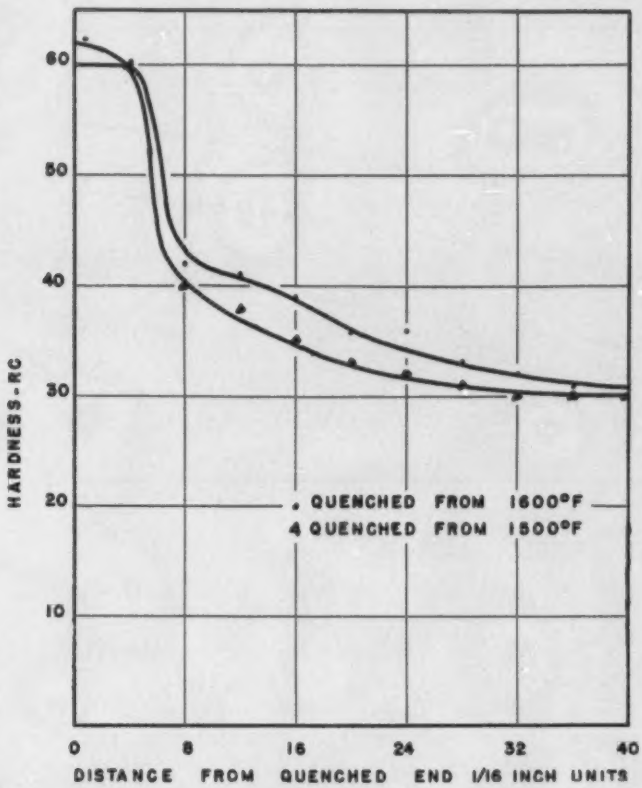

Fig. 9—Test bar hardness, Plant X.

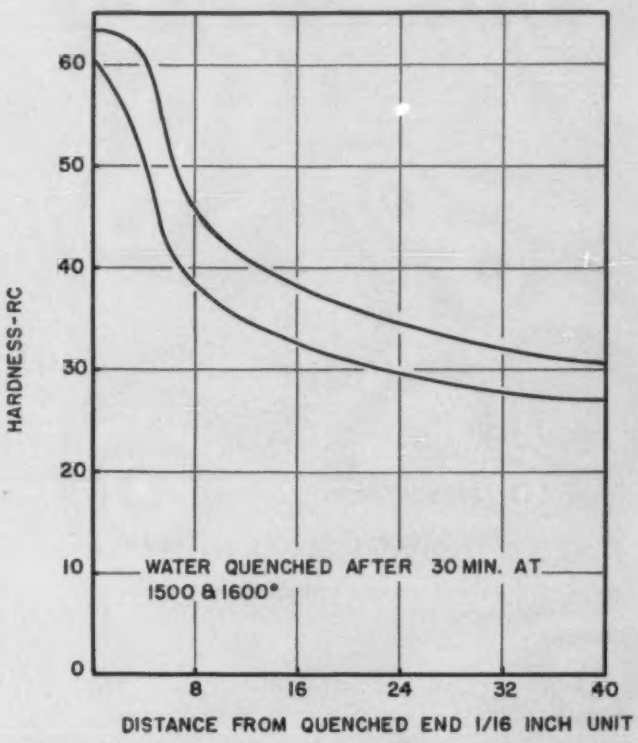

Fig. 10—Range of end quench curve data on pearlitic malleable from four different foundries.

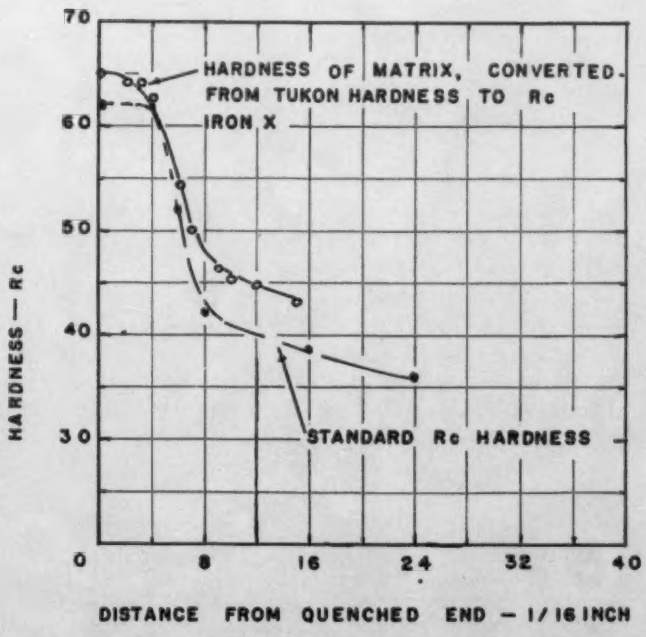

Fig. 11—Test bar matrix hardness, Plant X.

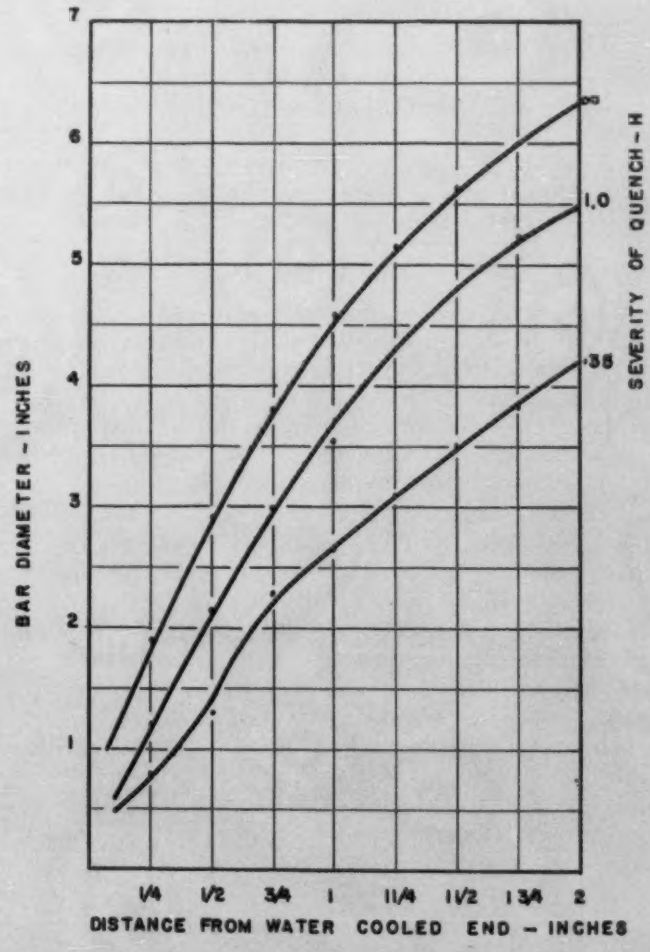

Fig. 13—Location on end-quenched Jominy hardenability specimen corresponding to the center of round bars.

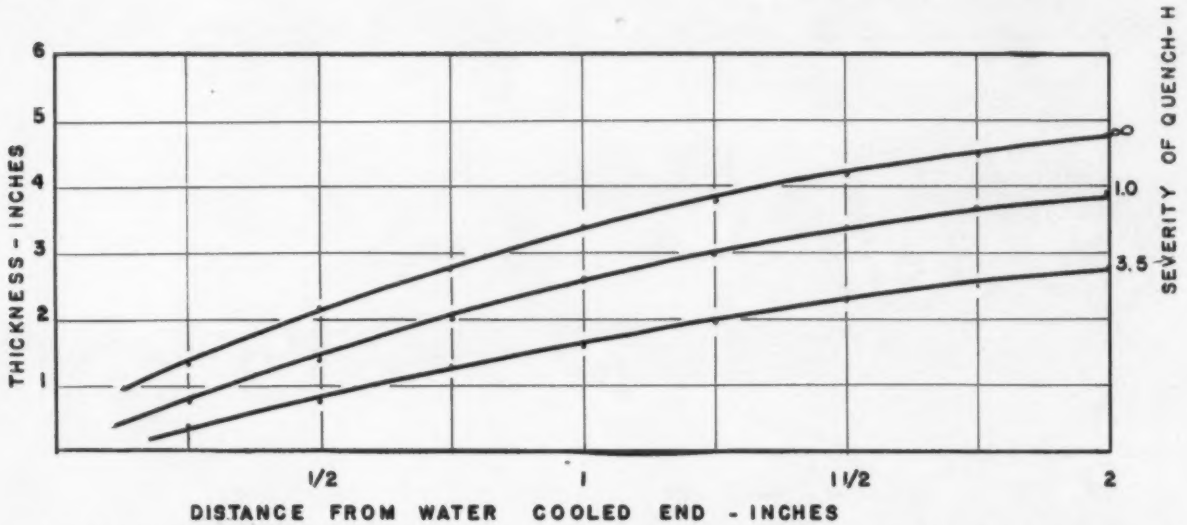

Fig. 12—Location of end-quenched Jominy hardenability specimen corresponding to the center of plates.

enability curve slightly compared with austenitizing at 1500 F.

3) The hardenability curves of irons from four foundries producing metal of similar chemical analysis fall in a remarkably narrow band. Figure 10 for irons *A*, *B*, *C*, and *X* of similar analysis from four foundries illustrates this point.
4) A lower hardenability curve was obtained for iron *I* having a low percentage of manganese and silicon; iron *I*, Table I. This curve is illustrated in Fig. 8.
5) A higher hardenability curve was obtained for an iron specially alloyed with manganese; iron *F*, Table *I*. This curve is illustrated in Fig. 7.

DISCUSSION

The normal hardenability range of pearlitic malleable as revealed in Fig. 10 reflects a lower maximum R_c hardness than should be obtained from a fully hardened martensitic structure. This is due to the fact that the graphite nodules in the microstructure cause the average hardness to be lowered about 2 to 3 points R_c. If hardness tests are made of the matrix, avoiding the nodules through use of the Tukon hardness tester, the full hardness characteristic of martensite is obtained. This effect is illustrated in Fig. 11 for iron from plant X, end-quenched by the standard method from 1600 F. Figure 11 shows that the matrix consistently develops higher hardness than the average hardness reported from standard R_c tests.

The normal hardenability range of pearlitic malleable iron is summarized in Fig. 10 for irons of the analysis of *A*, *B*, *C* and *X*. The band shown in Fig. 10 indicates that pearlitic malleable iron has end-quench hardenability similar to 1340, 4045 alloy steels and others.

The engineer may use the curves for estimating the response to quenching of castings in water or oil. Figures 12 and 13, taken from reference 3 for plates and cylinders, are presented to illustrate this point. On these figures, severity of quench, *H* of still oil is 0.35 and still water 1.0. Thus, if a 1.0 in. D round is quenched in oil, from Fig. 12 the hardness expected in the center should be the same as the hardness 0.60 in. from the sand of the hardenability bar.

This hardness is about 37 to 43 R_c on the band in Fig. 10. Figure 13 for plates can be used in a similar way. Of course, predictions of this type are subject to the limitations of accuracy known to those versed in the subject of hardenability as listed in reference 3. However, the end-quench curves provide the means for comparison of hardenability of pearlitic malleable iron with the hardenability of the various steels. The hardenability of the metal in turn determines the section size of castings which can be successfully hardened.

At present, the section sizes of pearlitic malleable which can be hardened by conventional heat treating are controlled by the intrinsic hardenability of the chemical analysis of the iron. Pearlitic malleables of higher hardenability could be made through alloying as practiced in steels.

REFERENCES

1. AFS Committee 6-E, "Comparison of Properties of Liquid and Air-Quenched Pearlitic Malleable Irons, Part I—Duplex Iron," TRANSACTIONS, AFS, vol. 64, p. 91-97, 1956.
2. AFS Committee 6-E, "Comparison of Properties of Liquid and Air-Quenched Pearlitic Malleable Irons, Part II—Duplex Cold-melt Process and Alloyed Pearlite Malleable Irons." Preprint 57-59, AFS, 1957.
3. W. Crafts, and J. L. Lamont, "Hardenability and Steel Selection," Pitman Publishing Company, New York.

AFS Forms Two New Technical Divisions

Creation of Ductile Iron Division Made in Chicago

Continued expansion of AFS technical activities to keep pace with growing phases of the casting industry has led to the creation of a Ductile Iron Division. The division was formed at an organizational meeting, Nov. 22 in Chicago.

Assurance was given at the meeting of sufficient support from the industry to sustain divisional activities. Committees will be formed with members representing producers, purchasers, and alloy suppliers.

C. W. Gilchrist nominated as chairman of Ductile Division.

Recommendations for divisional officers were made following a meeting of a nominating committee composed of five members of the Gray Iron and Malleable Divisions.

Officers nominated:

Chairman, AFS Director, C. W. Gilchrist, Cooper-Bessemer Corp., Mt. Vernon, Ohio.

Vice-Chairman, C. W. Ray, Deere & Co., Moline, Ill.

Secretary, David Matter, Ohio Ferro-Alloys Corp., Canton, Ohio.

Formal election of officers will be held after the mailing of a letter ballot. Additional nominations may be submitted on the ballot.

Seven groups were formed to consider the advisability of forming permanent committees. Each group will report at the next organizational meeting, tentatively set for Feb. 12 in Chicago.

The committees and individual assigned to prepare a statement of responsibilities.

■ Melting methods—Eric Welander,

Continued on page 54

Die Casting & Permanent Mold Officers are Named

Active participation in AFS technical activities is now underway by the recently formed and approved Die Casting & Permanent Mold Division. The division was formed from the requisite and evident mounting interests in the technical phases and operational techniques necessary to better serve the industry.

Temporary officers were appointed at the division's meeting held Oct. 22, 1957 in Chicago, to serve until May 1959. The officers are:

Chairman, D. L. Colwell, Apex Smelting Co., Cleveland.

Vice-Chairman, F. C. Bennett, Dow Chemical Co., Midland, Mich.

Secretary, R. P. Dunn, Clarendon Hills, Ill.

All officers were formerly active on the Die Casting Committee of the Light Metals Division, Colwell served as committee chairman.

Among the activities of the division will be the sponsoring of fundamental research on die and mold problems, preparation of technical articles, and participation in technical affairs. The division will jointly spon-

D. L. Colwell now serving as chairman of new AFS division.

sor with the Light Metals Division a round-table luncheon program at the 1958 AFS Convention.

Committees were formed as a result of response to a questionnaire circulated among die casting and permanent mold casting producers. Five committees were created with the following initial personnel:

Executive—Chairman D. L. Colwell, F. C. Bennett, E. V. Blackmun,

Continued on page 54

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AFS 1896

AFS NEWS

Ductile Iron Division

Continued from page 53

John Deere Malleable Works, East Moline, Ill.

- Basic metallurgy—K. D. Millis, International Nickel Co., New York.
- Gates & risers—T. W. Curry, Lynchburg Foundry Co., Lynchburg, Va.
- Alloying to produce ductile iron—A. J. Fruchtl, James B. Clow & Sons, Coshocton, Ohio.
- Welding—H. W. Ruf, Grede Foundries, Inc., Milwaukee.
- Quality control—C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Ala.
- Heat treating—W. D. McMillan, International Harvester Co., Chicago.

Technical papers on ductile iron, submitted for the 1958 AFS Convention, will be referred to the present Gray Iron Division for review and sponsorship. The Ductile Iron Division's program and papers committee will make plans for the ductile iron program at the 1959 Convention.

Die Casting Division

Continued from page 53

R. P. Dunn, D. L. LaVelle, R. G. McMillen, C. E. Nelson, N. Sheptak, and F. L. Turk.

Program & Papers—Chairman F. C. Bennett, E. V. Blackmun, M. E. Brooks, C. B. Curtis, J. W. Meier, G. V. Shomos, and L. W. Wickson.

Research—Chairman N. Sheptak, W. Babington, A. DeRoss, G. Hodgson, J. W. Meier, J. G. Mezoff, and E. Porter.

Alloys—Chairman F. L. Turk, H. C. Ahl, A. Y. Bethune, W. M. Brammer, F. N. Eaton, T. J. Fladgen, W. J. Klayer, P. W. Olson, B. L. Meredith, and A. J. Prickett.

Die & Mold Material—Chairman R. G. McMillen, J. S. Bilby, K. B. Bly, R. C. Cornell, H. E. Eriksen, G. H. Found, W. J. Grassby, F. W. Kidney, F. E. Lohse, and K. E. Nelson.

Tentative Program 62d Castings Congress
American Foundrymen's Society
Cleveland, May 19-23, 1958

MONDAY, MAY 19

7:30 am . . . Author-Chairman Breakfast
8:00 am . . . Registration Opens Exhibits open 8:30 am—5:30 pm
9:00 am . . . Technical Sessions: Pattern; Steel; Malleable (9:30 am)
12:00 noon . . . Round Table Luncheon: Steel
2:30 pm . . . Technical Sessions: Sand; Pattern; Malleable
4:00 pm . . . Technical Sessions: Fundamental Papers; Sand
8:00 pm . . . Malleable Shop Course

TUESDAY, MAY 20

7:30 am . . . Author-Chairman Breakfast
8:00 am . . . Registration Opens
9:00 am . . . Technical Sessions: Pattern; Light Metals; Safety, Hygiene & Air Pollution; Steel Exhibits open 9:00 am—5:30 pm
12:00 noon . . . Round Table Luncheons: Malleable; Pattern
2:30 pm . . . Technical Sessions: Fundamental Papers; Light Metals; Sand
4:00 pm . . . Malleable Shop Course
6:00 pm . . . Canadian Dinner; Sand Division Dinner
8:00 pm . . . Sand Shop Course

WEDNESDAY, MAY 21

7:30 am . . . Author-Chairman Breakfast
8:00 am . . . Registration Opens
9:00 am . . . Annual Business Meeting and Annual Hoyt Lecture Exhibits open 11:00 am—5:30 pm
12:00 noon . . . Management Luncheon
2:30 pm . . . Technical Sessions: Education; Light Metals; Gray Iron; Sand
4:00 pm . . . Technical Sessions: Plant & Plant Equipment
7:00 pm . . . Annual AFS Banquet

THURSDAY, MAY 22

7:30 am . . . Author-Chairman Breakfast
8:00 am . . . Registration Opens
9:00 am . . . Technical Sessions: Brass & Bronze; Gray Iron; Heat Transfer Exhibits open 9:00 am—5:30 pm
12:00 noon . . . Round Table Luncheon: Light Metals
2:30 pm . . . Technical Sessions: Brass & Bronze; Industrial Engineering; Sand
4:00 pm . . . Technical Session: Light Metals
7:00 pm . . . AFS Alumni Dinner
8:00 pm . . . Gray Iron Shop Course

FRIDAY, MAY 23

7:30 am . . . Author-Chairman Breakfast
8:00 am . . . Registration Opens
9:00 am . . . Technical Sessions: Brass & Bronze; Gray Iron; Heat Transfer Exhibits open 9:00 am—5:30 pm
12:00 noon . . . Round Table Luncheons: Gray Iron; Brass & Bronze
2:30 pm . . . Technical Sessions: Brass & Bronze; Industrial Engineering; Sand; Gray Iron Shop Course

Extensive Technical Program . . .

An extensive technical program has been prepared for the 62d AFS Castings Congress combined with the AFS Foundry Show to be held May 19-23 in the Cleveland Public Auditorium.

Technical sessions will be held daily with three shop courses scheduled for evenings, and two during the day. Sessions will start at 9 am daily except Wednesday when the annual AFS business meeting and Hoyt Lecture take place.

Authors and technical chairmen will meet daily at breakfast to discuss the day's program. The author-chairman breakfasts, originated at the 61st Castings Congress, held last year in Cincinnati, allow speakers and chairmen to meet and make final arrangements for the technical sessions.

Silicon and its ramifications has been selected as the subject of the Charles Edgar Hoyt Lecture to be delivered by W. E. Remmers, Union Carbide Corp. The annual lectures are devoted to technological and managerial subjects.

Technical lectures will be supplemented by luncheons, dinners, and shop courses. Five shop courses will be held during the Castings Congress. The Malleable and Gray Iron Divisions will each conduct two with the Sand Divisions sponsoring one.

The Malleable Division has selected "Malleable Supplement Heat Treatment" as its theme. The subject has been divided into four categories:

Induction heating
Flame heating
Bath heating—lead or salt
Complete heating.

"Improvement of Casting Quality Through Sand Control" has been chosen as the theme of the Sand Division shop course. Emphasis will be placed on dimensional and surface finish control.

The Gray Iron Division will present shop courses on basic microstructures and heat treatment.

Technical papers continue to be received at the Central Office for consideration. Those received since publishing the list in the December MODERN CASTINGS include:

"Investigation of the Hardening of Sodium Silicate Bonded Sand."
"The Parlanti Mould Process for the Castings of Metal by Controlled Rate of Heat Transfer."
"Elimination of Leaking in a Gun Metal Casting."
"Effect of Impurities upon the Resistance to Corrosion of Magnesium Casting Alloys AM262 and AM266."
"Molding Sands—Mixing and Uniformity."
"Hardenability of Pearlitic Malleable Iron."
"Evaluation of Shell Molding Process Capsability."

Cleveland Auditorium, site of 62d Castings Congress & Foundry Show

AFS 62d Castings Congress Banquet Committee

Members of the AFS Banquet Committee have been announced by Emil J. Romans, General Convention Committee Chairman. All members belong to the Northeastern Ohio Chapter, the host chapter. The banquet will be held Wednesday, May 21, at 7 pm.

Chairman, A. D. Barczak, Superior Foundry, Inc.
Vice-Chairman, Eugene L. Buchman, Ford Motor Co., Cleveland Foundry.
E. R. Crosby, Smith Facing & Supply Co.
Gilbert J. Nock, Nock Fire Brick Co.
Leon F. Miller, Osborn Mfg. Co.
Warner B. Bishop, Archer-Daniels-Midland Co.
Richard A. Green, Eastern Clay Products
Charles Seelbach, Jr., Forest City Foundries, Inc.
Joseph E. Dvorak, Eberhard Mfg. Co.
George E. Wills, National Malleable & Steel Castings Co.
Walter Sicha, Aluminum Co. of America. Dept., International Minerals & Chemicals Corp.
John H. Tressler, Hickman, Williams & Co.

. . . Backs Up Biggest Foundry Show

Cleveland appears assured of being host to the largest industry-wide Foundry Show ever sponsored by AFS. Applications for space in the Cleveland Public Auditorium continue to be received at a record rate and assignments are being made to maintain balance throughout the exhibition halls.

Over 225 leading domestic and foreign equipment manufacturers and suppliers will be present at the Foundry Show to be held May 19-23. Heavy emphasis this year will be placed on working exhibits and the introduction of new equipment.

The importance of the Foundry Show to the casting industry was stressed by F. W. Shipley, former AFS President, in addressing the annual meeting of the Foundry Equipment Manufacturers' Association in October. He stated:

"I know of no way to present a product to so many people at so little cost per prospect as at this exhibit where the prospect can see, hear, and even feel the products. At this show will be the greatest concentration of progressive foundrymen assembled anywhere and a great many of them will come from the small and medium-sized foundries."

"These men are there for only one purpose. They, too, want to learn and improve their operations. So they come to the one place where the very latest improvements in foundry equipment will be on display."

To date 22 exhibitors have each been assigned 1000 or more square feet of space in the Cleveland Public Auditorium by AFS Exhibit Manager W. N. Davis. Their products range from alloys to shakeout equipment and comprise all phases of production, including binders, molding machines, ovens, dust collectors, cupolas, and materials handling equipment.

One exhibit from England will have all phases of an operating foundry except for melting facilities.

The largest exhibitors as of Nov. 15 include:

Allis Chalmers Mfg. Co., Milwaukee.
Archer-Daniels-Midland Co. and Federal Foundry Supply Co., Cleveland.
Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago.
C & S Products Co., Detroit.
Carver Foundry Products Co., Muscatine, Iowa.
Davenport Machine & Foundry Co., Davenport, Iowa.
Electro Metallurgical Co., Div. Union Carbide Corp., New York.
Foundry Equipment Co., Cleveland.
Foundry Equipment, Ltd., Bedfordshire, England.
Freeman Supply Co., Toledo, Ohio.
Frank G. Hough Co., Libertyville, Ill.
Link-Belt Co., Chicago.
Modern Equipment Co., Port Washington, Wis.
National Cylinder Gas Co. and Girdler Co., Chicago.
National Engineering Co., Chicago.
Newago Engineering Co., Newago, Mich.
Osborn Mfg. Co., Cleveland.
Pangborn Co., Hagerstown, Md.
Vacu Blast Co., Belmont, Calif.
Wheelabrator Corp., Mishawaka, Ind.
Whiting Corp., Harvey, Ill.
Yale & Towne Mfg. Co., Philadelphia.

Technological Progress in Annual TRANSACTIONS

■ Foundrymen who wish to keep abreast of technological progress in their industry will find the new AFS publication, 1957 ANNUAL TRANSACTIONS—Volume 65, invaluable. The book includes all the transaction papers presented at the 1957 AFS Castings Congress at Cincinnati.

These papers represent the latest technological advancements.

Order your copy by writing to: Book Department, American Foundrymen's Society, Golf and Wolf Roads, Des Plaines, Ill. Price for AFS members, $10.00; non-members, $15.00.

National News

Foundry Management Hears How to Cut Rising Cost of Industrial Accidents

■ Legal aspects of safety, industrial hygiene factors in foundries, benefits of first aid, and foundry heating and ventilating were outlined to foundry management personnel in a two-day training course held Nov. 21-22 at Beloit Vocational and Adult School, Beloit, Wis.

The course was sponsored by Northern Illinois & Southern Wisconsin, Wisconsin, and University of Wisconsin Students Chapters of the American Foundrymen's Society. R. A. Oster, AFS Director, served as chairman.

Grouping of sessions around themes provided concentration on various subjects. The opening meetings were devoted to the economic losses suffered through foundry accidents. H. J. Weber, AFS Director of Safety, Hygiene & Air Pollution Program, pointed out that indirect costs of accidents were four times as expensive as the obvious direct costs. An accident entailing an insurance cost of $1000 actually represents a $5000 loss.

A summary of the Workmen's Compensation law was given by J. J. Bloomquist, Employers Mutual of Wausau; causes and sources of foundry accidents were detailed by J. Young, International Harvester Co.

Demonstrations

Four demonstrations were conducted Thursday afternoon. The use of dry powdered chemicals for extinguishing gas and spill fires were shown by M. J. Dalton, Great Lakes Fire Equipment Co. and W. Vodak, Walter Kidde Co. A six-man first-aid team from Ansul Chemical Co. demonstrated the latest in first aid techniques and outlined their first-aid program. J. H. Helm, Mine Safety Appliances Co., surveyed the available personal protective equipment now on the market.

The importance of cleaning and painting foundry areas was discussed by I. M. Emery, Massillon Steel Castings Co. Mr. Emery stated that good housekeeping pays off with increased working space, decreased accidents, and improved worker morale.

Friday's program opened with an illustrated lecture on the correct use of foundry chains by J. Hogans, Fairbanks Morse & Co. followed by a discussion of an eye protection program and film dealing with safety attitudes by B. C. Reichelderfer, Caterpillar Tractor Co.

Correct lifting procedures were demonstrated through the use of a dummy model by J. G. Williams, Minneapolis Steel Castings Co. B. Berg, Allis-Chalmers Mfg. Co., presented an illustrated lecture on industrial hygiene and pointed out that AFS and insurance carriers can answer many problems of hygiene concerning small foundries.

Foundry Heating

The final session was devoted to foundry heating and ventilating. W. Hazard, Owens Illinois Glass Co.,

R. A. Oster

conducted a demonstration of radiant heating, emphasizing that most heat exposure problems are due to heat radiation and not heat convection. K. Robinson, General Motors Corp. criticized the present general method of heating foundries, stating that usually the air was incorrectly introduced and diffused.

H. J. Weber discussed foundry hygiene problems and general principles of foundry ventilation. A movie on foundry ventilation was presented by American Air Filter Co.

Norman Amrhein, chairman, Wisconsin Chapter, discussed *"The Foundry—A Better Place to Work."*

The program was concluded with a summary of the two-day meeting by Chairman Oster.

TRAINING & RESEARCH INSTITUTE . . . preliminary sketches of the proposed building have been submitted to the T&RI Trustees for their approval.

Plans for the Institute center around short, intensive courses and laboratory work. Lectures will be conducted in three classrooms designed to accommodate a varying number of students. Visual aid equipment and demonstration facilities will be built into two of the classrooms.

A major foundry bay area, approximately 50x65 ft, will be used for demonstrations in molding and melting processes and will include permanent installations of sand handling and melting facilities. Pattern shop and machine shop facilities will also be incorporated.

Proposed laboratories include:

Sand testing
Chemistry
Physical testing
Metallography
Spectrography
Photography
Weighing
Non-destructive inspection.

Included in the building will be a first-aid room, locker room, lunchroom facilities, and administrative offices.

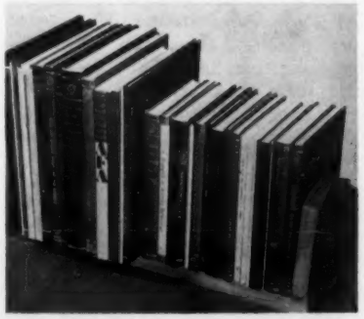
As indicated in the artist's sketch, the proposed building will adjoin the present National Headquarters in Des Plaines, Ill.

The Institute is devoted to educational and scientific development of the metal casting industry. It was created to aid the industry in retaining men through progressive in-plant advancement, provide upgrading of existing personnel through a series of job-training programs, and enable management to realize operating benefits through greater personnel efficiency and improved technology.

Develop Compact Book Case To Assist Sales

■ A convenient storage and display case has been designed by the National Office to stimulate book sales by chapters. All necessary equipment and materials to conduct book sales are contained in a storage case 12x 13½x22 in. The unit contains available AFS publications, a collapsible book rack, and order forms.

AFS headquarters will give the storage case and book rack to chapters purchasing a complete set of current AFS publications at the member price of $150. On book orders originating from chapter salesmen, a 20 per cent discount will be allowed.



It is suggested that each chapter appoint a committee to handle sales at meetings. The sale of a complete set of books will earn the chapter a $30 profit. Book sales will acquire additional funds for the chapter, extend its service to members, and make AFS publications available to the maximum number of foundrymen.

Birmingham was the first Chapter to place an order for a set of current AFS publications and the display case.

Chapter Membership Continues to Grow

AFS Chapters are responding to the challenge of increasing the Society's membership to 13,700 by the end of the fiscal year, June 30. Each month shows a continuing growth in members and Chapters reaching, or just missing, their quota.

On Aug. 31, the total membership was 13,048 with three Chapters were Northwestern Pennsylvania, Roachieving their membership quotas. These Chapters were Northwestern Pennsylvania, Rochester, and Central Indiana. Seven Chapters came within five of hitting their target—Ontario, Central Ohio, Western Michigan, Quad City, Wisconsin, St. Louis, and Timberline. By the end of September four chapters had made their quota and 10 had fallen just short. Chapters hitting June 30 targets were Northwestern Pennsylvania, Central Ohio, Michiana, and Wisconsin. Just missing were Canton, Ontario, Central Illinois, Twin City, Texas, Eastern Canada, Rochester, Quad City, St. Louis, and Timberline.

The AFS membership on Oct. 31 stood at 13,240 with nine chapters on target 15 falling five short.

Chapters making quotas were Eastern Canada, Ontario, Philadelphia, Central Indiana, Central Ohio, Michiana, Central Illinois, Twin City, and Wisconsin. Just missing were Northwestern Pennsylvania, Canton, St. Louis, Eastern New York, New England, Philadelphia, Rochester, Northern Illinois & Southern Wisconsin, Quad City, Mid South, Mo-Kan, Texas, Timberline, British Columbia, and Northern California.

AFS Committees in Action

Light Metals Division

■ At a meeting of the Light Metals Division and the Die Casting & Permanent Mold Division in October it was agreed to jointly sponsor a round table luncheon program at the 62d Castings Congress. With the formation of the new division, the Die Casting and Permanent Mold Committees of the Light Metals Division have been discontinued.

A total of 31 possible convention papers were discussed for presentation at the Castings Congress and assignments made for contact purposes.

Malleable Division

■ "Supplemental Heat Treatment of Pearlitic Malleable Iron" has been selected as the subject for the Division's shop course to be presented at the 62d Castings Congress. The Pearlitic Malleable Committee will plan and be responsible for this activity. Possible speakers were suggested at the October meeting and are being contacted to participate in the panel.

Preparation is underway by the Controlled Annealing Committee for its committee report to be presented at the Convention.

It will be entitled "Some Malleable Microstructures—Effect and Cause." Committee Chairman L. R. Jenkins will prepare and present the paper with other Committee members available as a panel to participate in the discussion period.

Sand Division

■ Preparation for participation in the Castings Congress and division organization were covered at October meetings of the Executive and Program & Papers Committees in Chicago.

"Improvement of Casting Quality through Sand Control" has been selected as the theme of the division's shop course.

A four-man panel will present the material emphasizing dimensional and surface finish control. Fourteen possible papers were discussed.

Four divisional committees were granted appropriations to cover expenses for equipment and supplies necessary to conduct their experiments. The committees were:

- Physical Properties of Steel Foundry Sands at Elevated Temperatures Committee—to complete a group of tests necessary to cover several sands not yet investigated.
- Shell Molding Materials Testing Committee—for core box.
- Molding Surface Committee—for Wood's metal and rental of necessary instruments.
- Physical Properties of Iron Foundry Molding Materials at Elevated Temperatures Committee—for a dilatometer, labor and materials, and conducting tests.

Divisional activity consisted of committee assignments and changes in committee personnel. Several committees will be reorganized.

Committees and their activities:

- Materials Used in Malleable Foundries Committee—will study the factors responsible for pinhole porosity in malleable castings.
- Sand Handbook Revision Committee—will revise the present handbook.
- Shell Molding Materials Testing Committee—will develop a test for resin-bonded sands to evaluate the tendency of shell molds and cores to develop thermal cracks on pouring.
- West Coast and Canadian Committees—it was suggested that these committees select one of four suggested programs for study.

These suggestions included: 1) nature of stress strain curve and its relationship to density and mold wall movement; 2) investigation of possibility of developing a test for evaluating the flowability of core sands; 3) development of a test for evaluating air set core binders; 4) development of a test for evaluation of sands.

Gray Iron Division

■ Divisional organization and preparations for the Castings Congress were discussed at a meeting of the Division's Executive and Program & Papers Committee held during October in Chicago.

Thirteen papers were reported either available or soon to be available. Five of the papers are definitely committed.

At the request of Division Chairman H. W. Lownie, Jr., AFS Technical Director S. C. Massari reviewed the new policy of preprinting technical papers as a Bonus Section in Modern Castings in lieu of separate reprints. All papers will be published in the annual TRANSACTIONS with both oral and written discussions.

The following reports were made by various committees of the Division:

- Shop Course Committee—"Basic Microstructures" was suggested as a possible subject for one of the two division shop courses.
- Research Committee—A progress report will be available for presentation at the Castings Congress.
- Chill Test Committee—Removed from stand-by and will cover the field of chill testing and the densifying effect of chills on gray iron.
- Gating & Risering Committee—Suggested that this committee be reorganized to conduct tests in conjunction with the Research Committee.
- Heat Treatment of Cast Iron Committee—Will prepare a presentation for the shop course.
- Effect of Temperatures on Properties of Cast Iron Committee—Warren Spear, Worthington Corp., has accepted chairmanship of committee replacing R. J. Allen, also of Worthington Corp. Committee will continue on stand-by basis.
- Inoculation Committee—Remains on stand-by.
- Microstructure of Cast Iron Committee—Will write paper on microstructure for the 1958 Convention. Further suggested that Committee develop standards for microstructure of nodular iron, similar to those available on gray iron.
- Test Bar Design Committee—Presently on stand-by.
- Round Table Sub-Committee—Formed to plan round table discussion and to report to the Program & Papers Committee.

Cupola Advisory Sub-Committee

■ Tuyere design, performance, and blast penetration were recommended for study by the Cupola Advisory Policy Sub-Committee at a meeting held in October at Roanoke, Va. The subject was selected as having the greatest interest to all parties.

H. W. Lownie, Jr., Battelle Memorial Institute, Columbus, Ohio, disclosed that Battelle has prepared a proposed research program dealing with the subject but had not attempted to obtain sponsorship.

The Sub-Committee recommended sponsoring and assisting such a program. Assistance would include advice in planning of experiments, analysis of results, and assistance in commercial trials.

The Sub-Committee, later visited Lynchburg Foundry Co., Lynchburg, Va., to observe the shell mold foundry, specialty foundry, use of protruding water-cooled tuyeres, and desulphurization practices.

It was decided that the general committee should meet at least twice a year. One meeting would be a plant-visitation type starting with an evening session the night before the visit. One meeting would be held in Chicago.

Western Michigan Holds Two-Day Foundry Course

■ Lectures, practical demonstrations, and work periods were used to provide 16 foundry instructors in the Kalamazoo, Mich., area with an improved understanding of metal casting.

The foundry session was one of eight sponsored Nov. 9 by the Industrial Arts Department of Western Michigan University, Kalamazoo, Mich. John L. Bendix, assistant professor, served as chairman.

Talks included: a discussion of the American Foundrymen's Society and the school foundry by A. B. Sinnett, AFS Assistant Secretary; and "Foundry in the School's Industrial Arts Program," by G. A. Aten, machine shop instructor, Battle Creek Public Schools, Battle Creek, Mich.

Demonstrations and work shops were used to illustrate basic methods and to give practical experience.

Personalized instruction was obtained by dividing the group into morning and afternoon sessions.

During the work period the students rammed and poured molds, observed a CO_2 demonstration, participated in chalk talks on gating and risering problems, and discussed the physical layout of school shops.

The desire of the instructors to acquire a practical understanding of foundry practices was illustrated by an evaluation of the program.

Students learn fundamentals through practical experience.

Everyone present felt that the work shop was highly important and 50 per cent indicated that even more time could be devoted to this phase of the program.

Supplies and equipment for the school's foundry have come from a variety of sources. The sands and aluminum scrap are donated by local firms. Some tools have been salvaged from an old foundry. The molding benches were made by a student at the University.

Chapter News

Northern California Begins with Diversified Program

Chapter Starts Season with Outing and Technical Session

■ Two events in September opened the social and technical program for the Northern California Chapter. H. J. Weber, AFS Director of Safety, Hygiene, and Air Pollution Control discussed the current status of legislation affecting foundries.

At an earlier meeting Mr. Weber addressed a luncheon meeting sponsored by the Chapter and attended by 26 representatives of management. The group discussed the local air pollution regulations being issued by the Bay Area Air Pollution Control District.

Speaker Weber is flanked on left by Chairman Hirsch and Vice-Chairman Gordon Martin.

The annual outing and golfing tournament was held Sept. 27 at the Mira Vista Country Club, El Cerrito, Calif. Prizes were awarded for winners in the 18 hole tournament, a hole-in-one contest, and a putting tournament.

Low gross winners among members were Terry Boscacci, Frank J. Roberts, and Harris M. Donaldson. Low net winners were Mike E. Ginty, Burt Christensen, and Don Pedrotti. Winners in the putting tournament for members and guests were Don Gonsalves, Burt Christensen, Roy Hoag, Frank Roberts, Stan Woulf, and Herman Pfeifer.

Winner in putting contest, Burt Christensen, accepts award from Mike E. Ginty.

The committee handling the outing and tournament were Vince Monte Verda, chairman; Mike E. Ginty, Edwin Berger, Seward Shaver, and Herman Pfeifer.

In October the Chapter was addressed by AFS President Harry W. Dietert who discussed *"Man vs. Horse Power."*—*H. E. Henderson.*

Attending the October meeting were Chapter Director Mike E. Ginty, AFS Director John Russo, AFS President H. W. Dietert and Chairman Hirsch.

Present 8 Student Scholarships at Chicago's November Meeting

■ November's meeting of the Chicago Chapter was highlighted by the presentation of Robert E. Kennedy and Foundry Educational Foundation Scholarships to students who showed outstanding aptitude and interest in the foundry industry.

Dean Frederick Trezise, University of Illinois, Navy Pier Branch, spoke of the critical need for highly trained people to meet needs of industry. He pointed out the industry's responsibility in training and educating future engineers and technicians and stressed this responsibility is even greater in view of the current world situation.

Prof. Roy W. Schroeder, also of the Navy Pier Branch, University of Illinois, explained how students are chosen for scholarship awards. The student's scholastic ability, foundry employment record during summer and part time work, and personality and character traits form the basis for scholarship awards. Prof. Schroeder then presented the Robert E. Kennedy Scholarships to University of Illinois students Gunther G. Wackerman, Thomas R. Hoogervorst and Roy G. Hlavacek. Funds are made available to this Scholarship Fund by the Chicago area foundry industry.

After a brief statement on the part that the F.E.F. is taking in encouraging and helping students in the field of foundry science and engineering, C. V. Nass, President of the Foundation, presented F.E.F. Scholarships to Charles J. Maurer, Howard E. George, James T. Clausen, George M. Bennett and William A. Workman.

John Rassenfoss, left, presents check from American Steel Foundries to Dean Trezise. Others are Robert Schauss, Chicago Kennedy Scholarship Chairman, and Chapter Chairman W. O. McFatridge.

F.E.F. Scholarships are awarded students of Foundation affiliated Universities in the United States through funds available by F.E.F. members.

A $750 contribution was made to the Robert E. Kennedy Scholarship fund by the American Steel Foundries. The check was presented to Dean Trezise and Robert P. Schaus, chairman of the fund, by John A. Rassenfoss.—*E. K. Burch*

Participating in scholarship night at the Chicago Chapter were, left to right: Dean F. Trezise, Gunther G. Wackerman, Thomas R. Hoogervorst, Prof. Roy W. Schroeder, Roy G. Hlavacek, Robert Schauss, and William O. McFatridge.

Philadelphia Chapter Repeats 16-Week Education Program

Program includes shop work, lectures, and plant visits

■ Philadelphia Chapter's educational course in practical foundry study is now in the third month of operation. Once again the course is being held during a 16-week period with classes conducted weekly in the new foundry building of Murrell Dobbins Vocational Technical School, Philadelphia.

Coremaking is one phase of foundry operations covered.

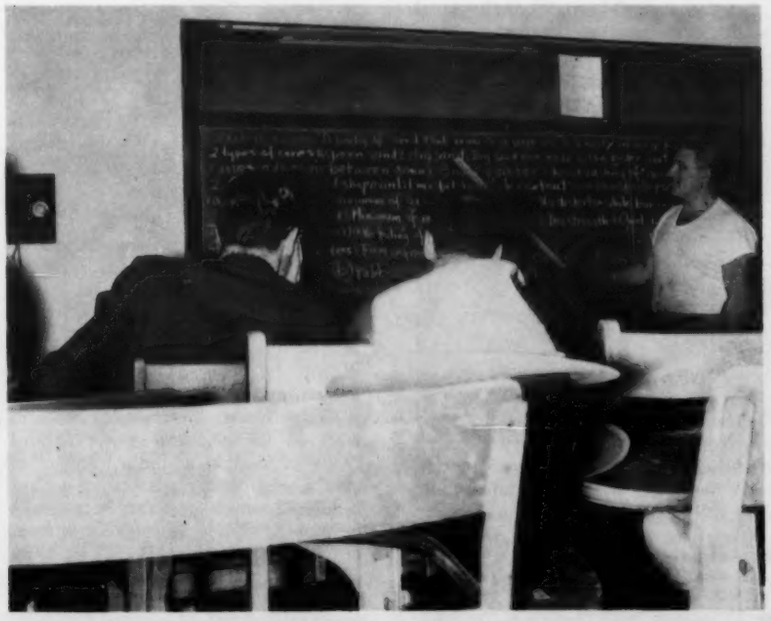
The course is designed to provide a working knowledge of foundry operations to persons not directly connected with molding or coremaking. Among those attending are patternmakers, machinists, engineers, draftsmen, designers, buyers, inspectors, salesmen, and technicians in the chapter area.

Included in the course are green sand molding with various types of patterns, coremaking, and the melting, pouring and handling of metal. Students participate in all operations to gain a first-hand knowledge of the basic processes. The school is equipped with both cupola and gas-fired furnaces.

Students will also attend lectures and demonstrations and make two plant visits to local foundries.

The program was devised by the Chapter's educational committee headed by Chairman E. X. Enderlein, H. G. Enderlein Co., Philadelphia, and Assistant Chairman Jack Schrader, Olney Foundry, Link-Belt Co., Philadelphia. *—E. C. Klank*

Shop work gives students knowledge of fundamentals.



Murrell Dobbins foundry instructor, Edward Saks, conducts lecture.

Eastern Canada Chapter

Discuss Molding Methods

■ More than 125 members and guests attended the November meeting featuring a discussion of three new molding methods. All talks were illustrated with film and slides.

J. Keech, Archer-Daniels-Midland (Can.) Ltd., spoke on *"Quick Setting Core Oils,"* listing applications, advantages, and disadvantages. Ease of collapsibility and reduction of hot tears were cited as advantages. Reclaimed sand from the air set process was said to have no detrimental effect on molding sand systems, and can be handled successfully in any sand reclamation unit.

V. H. Furlong, Foundries Services (Can.) Ltd., discussed the *"CO_2 Process,"* with emphasis placed on small and intricate core work being done in Canada.

W. R. Moggridge, Ford Motor Co. (Can.) Ltd., spoke on *"Some Experience with Shell Cores,"* reviewing various practices available to produce shell cores. The speaker outlined advantages and disadvantages of the process supplemented with slides and cost comparisons. He described the shell core as one alternate method which must compete on an economic and quality basis with CO_2 and conventional oil-cereal sand cores.— *F. Machin*

Attending the November meeting of the **Eastern Canada Chapter** which featured discussions of three molding methods were, left to right: Chapter Vice-Chairman M. Reading, speaker V. H. Furlong, R. Woods, Chapter Chairman P. Von Colditz, speaker W. R. Moggridge, Chapter Director K. Scanlon, speaker J. Keech, Chapter Secretary L. Myrand, and Chapter Director W. Tibbits.

Piedmont Chapter

Cores and Core Washes

■ November's meeting was held at Charlotte, N. C. Plant tours were made at Queen City Foundry Co. and Charlotte Pipe & Foundry Co. prior to the technical session. J. A. Gitzen, Delta Oil Products Co., Milwaukee, was the technical speaker discussing *"The Physical and Chemical Properties of Cores and Core Washes."*

Cincinnati Chapter

Foundry Mechanization

■ Mechanization in small foundries was described to 130 members at the October meeting by C. V. Nass, Beardsley & Piper, Div. of Pettibone Mulliken Corp., Chicago. It was pointed out that small foundries are lagging behind larger shops in mechanization and modernization. However, smaller shops are able to increase their operating efficiency through mechanization of certain operations, particularly in materials handling.—*J. D. Claffey*

Saginaw Valley Chapter

Ferrous and Non-Ferrous Sessions Held in November

■ Approximately 250 members attended the November meeting held at Frankenmuth, Mich. Following dinner, ferrous and non-ferrous technical sessions were held.

Carleton C. Hitchcock, R. C. Hitchcock & Sons, Inc., Minneapolis, discussed *"Horizons for the Non-Ferrous Foundry."* The ferrous group was addressed by Ralph A. Clark, Electro Metallurgical Co., Div. Union Carbide Corp., Cleveland, who outlined the selection of cupola charge materials. *—R. J. Gleffe*

Tri-State Chapter

Melting Brass and Bronze

■ Melting, molding sands, and gating are the most important factors in pro-

ducing sound castings in brass and bronze, Tri-State Chapter members were told at their September meeting.

William M. Ball, Jr., R. Lavin & Sons, Inc., Chicago, listed other important factors as maintaining full furnace control, correct patching of ladles and furnaces, and precise tapping time and pouring temperatures.

Mr. Ball recommended a 10:1 air to gas ratio for the refining of metal. It was pointed out that individual plant research is necessary to determine the proper melting procedures for the various types of alloys.—*Leslie A. O'Brien*

St. Louis Chapter

Discuss Diaphragm Molding

■ High pressure molding techniques were explained at the November meeting by W. L. Adams, Eastern Clay Products Dept., International Mineral and Chemical Corp., Chicago.

Among the topics covered were the proper mold hardness, the percentage of scrap due to molding defects, the number of molds expected from high pressure molding, and a comparison with mold blowing and techniques of shell molding.

AFS Director Karl L. Landgrebe

W. L. Adams

outlined the Society's functions and plans. He congratulated the Chapter for reaching its 1957 membership quota assigned by the National Office. —*H. V. Boemer*

"Water-Cooled Cupola Practice" was discussed at the November meeting of the **Pittsburgh Chapter** by W. F. Dawson, Kelsey-Hayes Co., Detroit. Dawson used a cupola model to illustrate his talk.—*Walter Napp*

Penn State University students attend the November meeting of **Pittsburgh Chapter.** Alan B. Draper, Prof. of Industrial Engineering, second from left, was in charge. Students were guests as part of chapter's educational program.

Pittsburgh Chapter Chairman George J. Miklos, and Membership Chairman J. T. Parsons, inspect certificate from the AFS Central Office for hitting the 1956-57 membership target.

Northwestern Pennsylvania Board of Directors meeting, left to right: W. C. Peelman, S. B. Walkiewicz, Arthur Ostergard, Chapter Secretary Stanley Trezenski, James Markowitz, Chapter President W. R. Ferguson, Albert Gable, Membership Chairman Mrs. O. C. Bueg, R. L. Johnson, and W. J. Miller.—*Walter Knapp*

Ontario Chapter

Speakers Look Into Future

■ Two speakers at the November meeting dealt with the future of the casting industry. L. N. Schuman, National Malleable & Steel Castings Co., Cleveland, emphasized the importance of acquiring scientific talent in the industry and predicted increasing developments in the fields of melting, molding, and coremaking.

F. G. Steinbach, Penton Publishing Co., Cleveland, reviewed progress in the casting industry during the past 57 years and forecast an increase in casting production of 60 per cent by 1975.—*P. J. Provias*

Ontario Chapter

Two Speakers Address Chapter in October

■ Slag control in cupola melting, and non-ferrous melting and its effect on casting quality, were discussed at two sessions of the October meetings.

A. R. Alexander, International Harvester Co., Memphis, Tenn., explained how slag, consisting of burned refractories, dirt, oxides, and other impurities, was removed with aid of limestone. Slides were shown to illustrate methods of obtaining slag control with back slagging cupolas. Dams of various depths and sizes were used to maintain a proper well of iron. Mr. Alexander observed that: 1) small cupolas need a greater proportion of limestone than large cupolas; 2) accurate weighing of limestone is important; 3) slag can be used to control analysis and bridging condition in cupolas.

R. W. Ruddle, Foundry Services, Inc., Columbus, Ohio, presented an illustrated lecture on the effects of different fluxes and their effect on the quality of different types of non-ferrous metals. Emphasis was placed on good foundry housekeeping to improve casting quality. Question and answer periods were held following each talk.—*John Kenneth Senior, A. E. Simmons.*

Central New York

Round-Table Panels

■ Following two meetings in the Utica and Elmira areas, the chapter returned to Syracuse for the November meeting.

Two round-table discussions were held. The ferrous panel was composed of Joseph Otvos, Straight Line Founrry & Machine Co., Syracuse, N. Y., and assisted by Edward Fiesinger, Jr., Crouse Hinds Co., Syracuse, N. Y. Louis Iannettoni, Westinghouse Electric Co., Buffalo, N. Y., was chairman of the non-ferrous group.—*Carl Diehl*

"Quality Control in the Foundry" was featured at the **Toledo** October meeting with R. W. Gardner, Dearborn Iron Foundry, Ford Motor Co., as speaker. Topics discussed included control of raw materials, sampling, laboratory procedures, and metal analysis. Mr. Gardner was presented with a desk pen set by Martin Gruhler, Unitcast Corp., Toledo, Ohio. C. M. Hannaford, Unitcast Corp., center, served as technical chairman. The meeting, which opened the chapter's 1957-58 technical program, was held at the Heatherdowns Country Club with 90 members attending.

Oregon Chapter

Water-Cooled Cupolas

■ An illustrated lecture on water cooled cupolas was presented at the November meeting by Walter R. Jaeschke, Whiting Corp., Harvey, Ill.

Mr. Jaeschke said that foundries are turning to water-cooled cupolas because of the severe damage to linings due to corrosion, heat, abrasion, and chemical reactions in the production of low phosporus, low sulphur iron for nodular castings.

Cupolas were described, with and without linings, and with various types of tuyere and stack arrangements. Authoritative examples are lacking because reports from users frequently do not consider all factors. Foundrymen were cautioned to study melting conditions, type of castings, and other factors before installing water-cooled cupola melting facilities. —*Bill Walkins*

Casting Industry Joins with Others in Outlining Benefits to Students

■ A relatively new approach for attracting young men into industry has worked successfully. The cooperative plan revolves around "Career Carnivals" sponsored by schools. Companies participating in the plan maintain booths similar to those of industrial shows.

The ninth annual Career Carnival was held in October at Michigan State University, East Lansing, Mich. Representatives from 76 companies from all phases of American industry were on hand to discuss training, backgrounds and qualifications of college students.

A booth representing the casting industry was sponsored by the American Foundrymen's Society and the Foundry Educational Foundation. The booth was supported by the Central Michigan, Western Michigan, Saginaw Valley, Detroit, and M.S.U. Student Chapters of AFS. The booth was manned by chapter members and F.E.F. students.

Jack Kinney, assistant director of the Michigan State University placement bureau, said that the Career Carnival provides an excellent opportunity for underclassmen to solidify their interest in some vocation area.

A panel discussion of finishing operations on castings was held at the December meeting of the **Central Indiana Chapter.** B. E. Gavin, National Malleable & Steel Castings Co., Indianapolis, served as technical chairman. Speakers were Kay Williams, Link-Belt Co., Indianapolis; R. G. Kimble, Fabricast Div., General Motors Corp.; Charles A. Newmier, Frank Foundries Corp., Muncie, Ind.; and Charles Neese, Electric Steel Castings Co., Indianapolis. Shown in picture left to right are speaker Gavin, Chapter Chairman W. M. Fitzsimmons, and Chapter Secretary W. E. Boyd.—*William R. Patrick*

Attending the **Central New York** November meeting were, left to right, Robert Knight, H. Knight & Sons; Floyd Lendrum, New York Air Brake Co.; Jack Bryant, Bryant Sand Co.; Louis Hylton, Meloon Bronze Foundry, Inc.; Daniel Julian, Syracuse Firebrick Supply Co.; and Nicholas Palastra, Meloon Bronze Foundry, Inc. The meeting was divided into ferrous and nonferrous discussions.—*Carl Diehl*

Wisconsin Chapter's November meeting featured five sessions. John A. Mueller (above), Carborundum Co., Niagara Falls, N. Y., discussed snagging and cut-off problems. Earl Woodliff (below), consultant, Detroit, spoke on malleable sand problems. Other speakers and subjects included: Harold B. Zuehlke, Allis Chalmers Mfg. Co., Milwaukee, *"Material Handling Tricks for Everyone;"* and Richard L. Olson, Dike-O-Seal, Inc., Chicago, *"Engineering Aspects of Core Box Design."* A panel of P. C. Fuerst, Falk Corp., M. V. Sporakowski, Bucyrus-Erie Co., and V. E. Ziemer, Maynard Electric Steel Castings Co., discussed *"Basic Concepts of Gating and Risering."* John T. Pace, Bucyrus-Erie Co. served as panel chairman and Vincent Mikelonis, Grede Foundries, Inc., as vice-chairman. *Bob De Broux*

Washington Chapter

Water-Cooled Cupolas

■ Water-cooled cupolas were discussed at the November meeting by Walter Jaeschke, Whiting Corp., Harvey, Ill.

The first applications of water-cooled cupolas were in Budapest, Hungary, prior to 1900. They were used to some extent in the United States during the 1920s and again during World War II.

Their most common use is in long runs where low sulphur iron is needed for nodular iron practice, and in operations using 100 per cent scrap. These cupolas use a 6-9 in. lining in a 16-18 hour operation using a water spraying method where the water temperatures are held to a maximum of 140 F.

The speaker warned foundrymen to make a thorough examination of all factors before considering the installation of water-cooled cupolas.—*Frank H. Jefferson*

Northwestern Pennsylvania

Deoxidation of Steel

■ Approximately 70 foundrymen attended the November meeting to hear Francis W. Boulger, Battelle Memorial Institute, Columbus, Ohio, discuss *"Deoxidation of Steel, A Review."—Walter Napp*

Speaker W. R. Jaeschke who addressed **Northwestern Pennsylvania** Chapter in September.

Northwestern Pennsylvania Chairman W. R. Ferguson congratulates speaker Boulger, who addressed the chapter in November, on the subject of **"Deoxidation of Steel, A Review."**

"Patterns and Profits" were discussed at the November meeting of the **New England Chapter** by Walter E. Carlson, Carlson Pattern Shop, Inc., Springfield, Mass. Shown in photo, left to right, are Chapter 1st Vice-President William N. Ohlson, speaker Carlson, Chapter President Alexander Beck.—*F. S. Holway*

Canton Chapter Tours Ford Foundry

■ Approximately 300 foundrymen from the Canton area toured the Ford Motor Co. Cleveland foundry in November. Chapter members participated in the 1½ hour tour following a dinner.—*Lester F. Stahler*

Getting there

Busses took members from dinner to Ford Motor Co. foundry located in Cleveland.

Arrival at plant

Assembling at plant where E. C. Jeter, plant manager, acted as host to Canton Chapter.

Touring foundry

Group examining experimental hand work on cores in one of country's largest gray iron foundries.

Cupola Operation

Central Ohio Chapter

■ Cupola operations – conventional and water-cooled, were discussed at the November meeting by Harvey E. Henderson, Lynchburgh Foundry Co., Lynchburgh, Va. Their experience in water-cooled cupolas started in 1951 with the melting zone of the original cupola cooled by water circulating in seamless steel tubes. Various modifications have been made in later installations.

In 1954 water-cooled cupolas were installed to produce both gray and ductile iron castings. These melt ductile iron continuously at temperatures in excess of 2950 F, reaching a maximum of 3050F. The charge consists of 50 per cent return scrap, 25 per cent selected steel scrap, and 25 per cent low carbon pig iron with a coke ratio of 9:1. Blast is heated to 850 F.

The cupolas are used about 75 per cent of the time in melting various grades of gray iron. They are much easier to control than conventional acid cupolas due to the selection of air blast temperatures available. The normal operating range of blast temperature is 400-600 F.—*Jose Acebo*

Timberline Chapter

Using Plaster and Plastics

■ Step-by-step procedures in using plaster and plastic patterns and core boxes were outlined at the November meeting by M. K. Young, U. S. Gypsum Co., Chicago.

The illustrated talk showed various applications of the processes as well as good and bad practices. Chapter Chairman D. C. Card presided. Vice-Chairman J. F. Taleck served as technical chairman.—*D. C. Card*

Studies Casting Defects

Casting defects were analyzed at the October meeting by T. E. Barlow, Eastern Clay Products Dept., International Minerals & Chemical Corp., Chicago. Mr. Barlow said that the main cause of defects are lack of uniformity in sand, moisture, molds, and other materials and procedures.

The speaker emphasized that there are several variables which can cause a defect—each defect has approximately 20 causes and each cause has approximately 20 defects. He recommended that foundrymen keep an open mind in analyzing casting defects and not arbitrarily assign causes for the defects.

afs chapter meetings

JANUARY

Birmingham District . . Jan. 10 . . Thomas Jefferson Hotel, Birmingham, Ala. . . L. B. Knight, Lester B. Knight & Associates, *"Let's Get Out and Sell and Get Ready to Sell."*

British Columbia . . Jan. 17 . . Pacific Athletic Club, Vancouver, B. C. . . W. M. Ball, Jr., R. Lavin & Sons, Inc., *"Copper-Base Alloy Foundry Practice."*

Canton District . . Jan. 2 . . Mergus Restaurant, Canton, Ohio . . *Panel of Four, "Know Your Neighbor."*

Central Illinois . . Jan. 6 . . American Legion Hall, Peoria, Ill. . . H. H. Kessler, Sorbo-Mat Process Engineers, *"Gating & Risering—Cupola Practice."*

Central Indiana . . Jan. 6 . . Athenaeum Turners, Indianapolis . . W. J. Hebard, Blaw-Knox Co., *"Human Engineering & Importance of Getting Along with Employees & Associates." Past Chairman's Night.*

Central Michigan . . Jan. 15 . . Hart Hotel, Battle Creek, Mich.

Central New York . . Jan. 10 . . Onondaga Hotel, Syracuse, N. Y. . . C. E. Wenninger, Beardsley & Piper Div., Pettibone Mulliken Corp., *"Pneumatic Sand Reclamation."*

Central Ohio . . Jan. 11 . . Seneca Hotel, Columbus, Ohio . . *Christmas Party.*

Chesapeake . . Jan. 11 . . Alcazar Ballroom, Baltimore, Md. . . *Annual Oyster Roast Party.*

Chesapeake . . Jan. 31 . . Engineers' Club, Baltimore, Md. . . F. D. Miller, Philadelphia Coke Co., *"Foundry Coke." Fanner Mfg. Co. Film, "Foundry Chaplets & Chills."*

Chicago . . Jan. 6 . . Chicago Bar Association, Chicago . . R. L. Reid, University of Chicago, *"Problems & Prospects in Executive Development." Management and Past President's Night.*

Cincinnati District . . Jan. 13 . . Alms Hotel, Cincinnati . . E. J. Walsh and L. P. Robinson, Foundry Educational Foundation, *"F.E.F. Activities in the Foundry Industry."*

Connecticut . . Jan. 11 . . Waverly Inn, Cheshire, Conn. . . *Holiday Party.*

Continued on page 65

Dignitaries attending the Niagara Frontier Regional Conference are, left to right: C. C. Furnas, University of Buffalo; O. J. Myers, Reichhold Chemical Co.; L. H. Durdin, vice-president, AFS; and E. J. Burke, president, Western New York Chapter, hosts of the Conference.

Niagara Region Foundrymen Prepare to Meet Changes Brought by Sea Way

P. R. FOGHT

Foundrymen on the Niagara Frontier expect their area's economy to expand with the development of the St. Lawrence Sea Way projects, so the program of the Niagara Frontier Regional Foundry Conference was planned as an exchange of information to meet the changing needs of their industry.

Technical presentations were grouped into six separate interests and these sessions were attended by a total of 253 foundrymen from the six sponsoring AFS chapters. The conference was held Oct. 24 and 25 at the Hotel Statler, Buffalo, N. Y., under the sponsorship of Western New York, Eastern New York, Ontario, Rochester, Northwestern Pennsylvania, and Central New York Chapters.

The conference program was under the direction of General Chairman Leonard Greenfield, S. Greenfield Co., Inc.

Speakers at the opening conference session were Dr. C. C. Furnas, University of Buffalo; AFS Vice-President L. H. Durdin; AFS Director O. J. Myers; and William Gude, Foundry.

In his talk, *"Present Status and Prospects for the foundry Industry,"* Mr. Gude noted a changing pattern in the metalcasting industry of the U. S. and Canada. In recent years, he stated, the total number of gray iron, malleable, and brass and bronze plants has declined while the number of aluminum foundries has increased.

■ **Patternmaking.** Ray Olson, Southern Precision Pattern Works, Inc., Birmingham, Ala., opened the patternmaker's program by introducing them to a new personality, the pattern engineer. In his talk on *"Pattern Engineering,"* Mr. Olson noted that the pattern engineer is the solution to the problem of maintaining close cooperation between tool engineers or machine and pattern shop supervision.

■ **Stainless Steel.** The first of two technical sessions programmed for producers of stainless steel castings presented E. A. Schoefer, Alloy Casting Institute, Mineola, N. Y., who spoke on *"Production Problems Encountered in Making Stainless Steel Castings."*

Mr. Schoefer reported that despite the problems of marketing, of manufacturing, and of quality control, "foundries actively engaged in high alloy casting production have found that with close attention to technical advances, adequate flexibility of production equipment and rigidly applied control and inspection techniques, they are able to meet the demands for high quality castings."

"Melting Stainless Steel" was described in a paper presented by L. W. Cashdollar, Pittsburgh Metallurgical Co., Cleveland.

Three areas in which pattern makers and pattern shops should seek improvement were pointed out in a talk on *"Latest Developments in the Pattern Industry"* delivered by Walter H. Siebert, Standard Pattern Works, Cleveland. The three points are: improve cooperation between foundry and pattern shop; foundry and pattern shop together must seek improved cooperation with the casting designer; and finally, the pattern

Continued on page 74

Purdue Metals Casting Conference Centers Around Foundry Practices

J. H. SCHAUM

The Practical Foundry—Today and Tomorrow—was the keynote of the Annual Purdue Metals Casting Conference, Oct. 31 and Nov. 1 in Lafayette, Ind. Over 175 foundrymen from Indiana, Illinois, Michigan, Ohio, Wisconsin, Missouri, and Alabama heard nine well-qualified men speak on the practical aspects of melting and molding.

Conference Chairman Carl O. Schopp, Link-Belt Co., Indianapolis, officially opened the conference by welcoming the delegates and introducing Dr. Paul Chenea, Assoc. Dean of the School of Engineering, Purdue University. Dean Chenea impressed the visitors with the magnitude of the task of keeping an engineering school abreast of rapidly changing technology. Metallurgy students comprise 2.6 per cent of Purdue enrollment—a figure which has not changed in the past 10 years.

AFS Vice-President L. H. Durdin addressed the metalcasting men on behalf of the Society and did some visioneering about the future of the industry. In the role of Foundry Educational Foundation president, C. V. Nass outlined F.E.F. plans to extend activities into technical institutes.

Credit for the careful selection of authoritative speakers appearing on the program was due to the efforts of the program committee headed by Chairman William F. Patterson, Elkhart Foundry & Machine Co., Elkhart, Ind. and Asst. Chairman Dallas F. Lunsford, Perfect Circle Corp., Hagerstown, Ind.

The traditional evening banquet provided relaxation through the talents of toastmaster R. W. Lindley, Purdue University. Prof. Lindley entertained musically at the piano and verbally at the microphone.

Guest banquet speaker, Peter Gerdes, Institute of Human Science, Chicago, provided food for thought in his talk *"Human Engineering."*

"What Cummins Engine Company Expects of Its Vendors" was the subject of the first technical talk presented by R. B. Stoner, Vice-President —Operations, Cummins Engine Co., Columbus, Ind.

Cummings wants its casting vendors to have integrity and good personnel relations and to be profitable, growing, progressive, and financially sound.

Studying the Purdue Regional Conference program are, left to right; D. F. Lunsford, Perfect Circle Corp.; J. B. Essex, Golden Foundry; C. O. Schopp, The Link Belt Co.; W. E. Patterson, Elkhart Foundry & Machine Co.; J. C. Maggart, Sibley Machine & Foundry Corp.; and C. T. Marek, staff member of Purdue University, site of the Conference.

"Control your scrap in the foundry, not in the shipping room!" was the advice of Henry Felten, Peoria Malleable Castings Co., Peoria, Ill., in his talk entitled *"Practical Scrap Reduction."* According to the speaker, if a particular defect exceeds one per cent it is out of control. At Peoria Malleable they have applied the theory of Kenneth McKay Smith *—if you control the process in the various defects so that every job that*

Continued on page 77

Castings Meet the Challenge

CATERPILLAR TRACTOR Moves into the Future with Castings

Skilled Caterpillar technicians seek better metals in new testing laboratory.

The ability of castings to satisfy the advancing needs of new frontiers is not limited to the glamor industries of space and speed. The Caterpillar Tractor Co., Peoria, Ill., is depending on castings to meet the challenge for more power and greater productivity per pound of machine. Quality cast metal parts are credited for many of the significant advances in heavy duty industrial tractors.

Belief in the importance of metals to their future has led Caterpillar to recently build a new Metallurgical and Materials Testing Laboratory. This modern, 22,000-sq ft laboratory is considered a necessary tool to check the quality and integrity of all materials going into their products. Here a trained staff of over 150 employees are dedicated to the task of linking together scientific knowledge, exploration of hidden material qualities, and practical product application.

Caterpillar's approach to meeting the challenge is categorized by their vice-president, C. A. Woodley, who recently stated, "Our new Production Metallurgical and Materials Testing Laboratory is an investment in the future and necessary to our continued progress!"

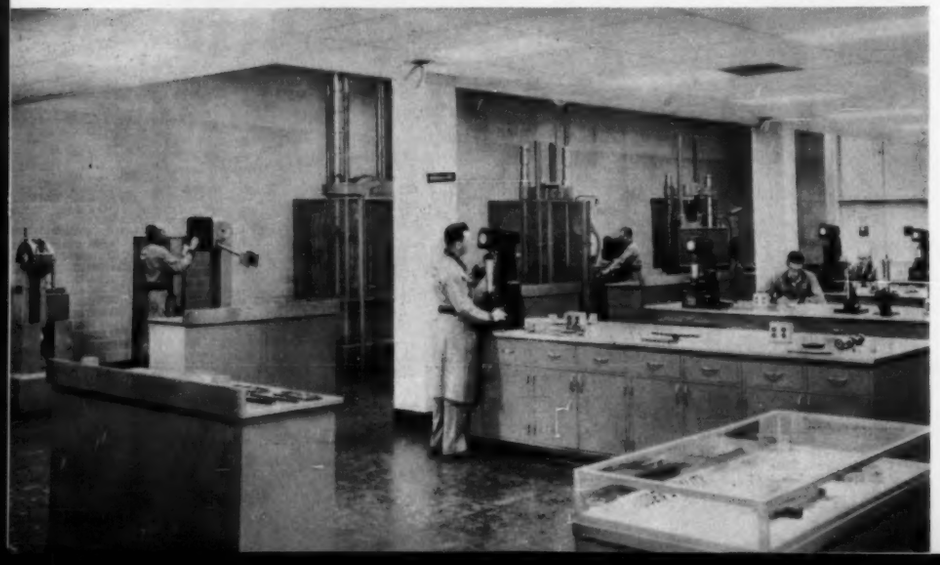
Caterpillar has long enjoyed a reputation for working closely with the many vendors supplying essential components of their equipment. Vendors are currently supplying 75 per cent of all cast parts.

An outstanding example of this customer-vendor relationship is that which exists with Harrison Steel Castings Co., Attica, Ind. The Harrison foundry has supplied steel castings for more than 42 years to Caterpillar and its predecessor. A cooperative research program on the part of both companies has resulted in the first commercially successful production of boron-bearing cast carbon steel using the acid open-hearth process.

This development eliminates the need for other expensive alloying elements, uses only 0.005 per cent of boron, and produces a steel with remarkable hardenability. As a result of its exceptional wear resistance, all crawler tractor sprockets for the D8 and D9 tractors are being cast in boron-bearing cast carbon steel. Over 20,000 sprockets have been produced in this alloy since October, 1956.

Caterpillar metallurgists have long worked on the theory that it is cheaper to develop maximum metal physical properties through relatively inexpensive heat treatments than by using expensive and often scarce alloys. So today 34 per cent of the 30-ton D-9 is subjected to heat treated.

Caterpillar employs 150 people in its laboratory to plan future developments.



Quantometer utilized to check that specifications of steel meet Caterpillar Co. standards.

Wheel sprockets being cast at Harrison Steel Castings Co. for use in Caterpillar plant.

Tractor sprocket casting of boron-bearing carbon steel receives dimensional check.

Chapter Meetings

Continued from page 62

Connecticut . . Jan. 28 . . Stratfield Hotel, Bridgeport, Conn. . . R. L. Olson, Dike-O-Seal, Inc., *"Core Blowing."*

Corn Belt . . Jan. 10 . . Fireside Restaurant, Omaha, Neb. . . H. J. Weber, AFS, *"Legislation Affecting Foundries."*

Detroit . . Jan. 16 . . Hotel Tuller, Detroit . . E. H. King, Hill & Griffith Co., *"Fundamentals of Molding Methods, Use and Preparation of Molding Sands."*

Eastern Canada . . Jan. 10 . . Sheraton-Mt. Royal Hotel, Montreal, Que. . . Z. Madacey, Beardsley & Piper Div., Pettibone Mulliken Corp., *"Core Blowing Techniques."*

Eastern New York . . Jan. 21 . . Panetta's Restaurant, Menands, N. Y.

Metropolitan . . Jan. 6 . . Essex House, Newark, N. J. . . F. E. Van Voris, Electro Metallurgical Co., Div. Union Carbide Corp., *"Modern Steel Melting Practice"*; H. H. Wilder, Vanadium Corp. of America, *"Cupola Operation"*; N. A. Birch, National Bearing Div., American Brake Shoe Co., *"Non-Ferrous Melting."*

Mexico . . *No information available.*

Michiana . . Jan. 13 . . Club Normandy, Mishawaka, Ind. . . D. L. LaVelle, Kaiser Aluminum & Chemical Sales, Inc, *"Major Aluminum Problems & Their Solutions,"* and J. F. Orloff, Central Foundry Div., GMC, *"Gating to Control Pouring & Its Effect on Castings."*

Mid-South . . Jan. 10 . . Claridge Hotel, Memphis, Tenn.

Mo-Kan . . Jan. 3 . . Fairfax Airport, Kansas City, Kans. . . M. K. Young, United States Gypsum Co., *"New Opportunities for the Pattern Industry."*

New England . . Jan. 8 . . University Club, Boston . . *Panel*: G. Bouldry, Whitman Foundry, Inc., *"Cupola Charging,"* and L. J. Iadarola, Pioneer Foundry & Mfg. Co., *"Molding."*

Northeastern Ohio . . Jan. 9 . . Tudor Arms Hotel, Cleveland . . W. K. Bock, National Malleable & Steel Castings Co., *"Is Quality Control Old Stuff in the Foundry?" Joint Meeting with American Society for Quality Control.*

Northern California . . Jan. 13 . . Spenger's Cafe, Berkeley, Calif. . . T. C. Bunch, Mare Island Naval Shipyard, *"Non-Ferrous Foundry Practice."*

Northern Illinois & Southern Wisconsin . . Jan. 14 . . Country Club, Beloit, Wis. . . *Panel on Molding Sand.*

Northwestern Pennsylvania . . Jan. 27 . . Amity Inn, Erie, Pa. . . H. H. Kesler, Sorbo-Mat Process Engineers, *"Gating & Risering."*

Continued on page 66

CONTROL MOISTURE . . .

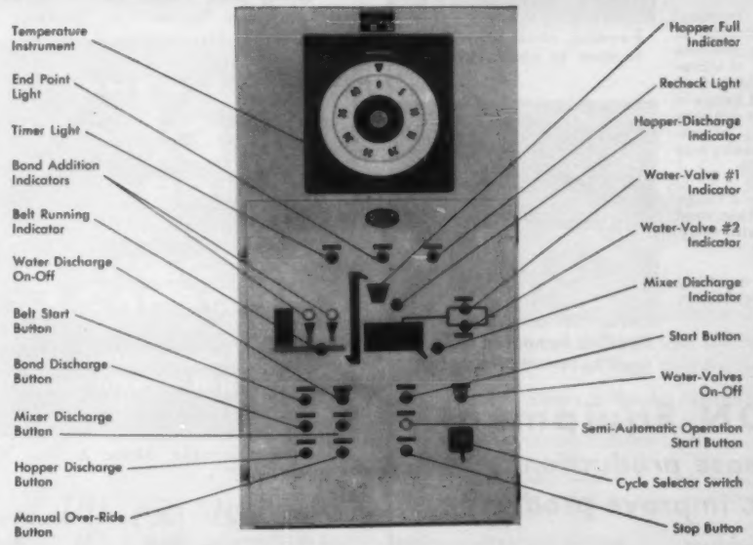
during the entire mixing cycle- AND...

ADD PROFITS!

YOU CAN DO IT BEST WITH A

DIETERT NO. 3907

End Point Automatic Moisture Controller



Unit illustrated is No. 3917 Combination Automatic End Point Moisture Controller and Automull.

The No. 3907 Dietert-Detroit End Point Automatic Moisture Controller . . . highly accurate and quality engineered along traditional Dietert lines . . . automatically regulates the addition of water to sand in a mixer, to produce tempered sand with any desired moisture content.

1. Continuous "recheck" throughout the mixing cycle protects against moisture loss and guarantees maximum accuracy.
2. Base water is added rapidly and blended in over the full cycle. Physical properties of every batch are fully developed.
3. End point is reached slowly to prevent overshooting and assure accuracy.
4. Sand is automatically discharged when correct moisture is stabilized. Cool batches that contain nearly tempered sand are quickly cycled through the mixer. Tonnage is increased and handling costs reduced.
5. Highest quality components minimize maintenance.
6. Constant batch size not necessary.
7. No moving parts in mixer.
8. Single dial controls swift, easy changes in the moisture level and handles a number of different sands.
9. Sealed, plug-in relays and delay timers assure fast, simple maintenance.
10. Cabinet is dust-proof NEMA type 12.
11. Includes remote panel box with sequence indicator lights and control switches.

MAXIMUM **molds per man**

KEEPS PRODUCTION **MOVING** No Costly Interruptions

REDUCES CASTING LOSSES LOWERS CLEANING COSTS

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Quotes you Complete with every accessory you need!
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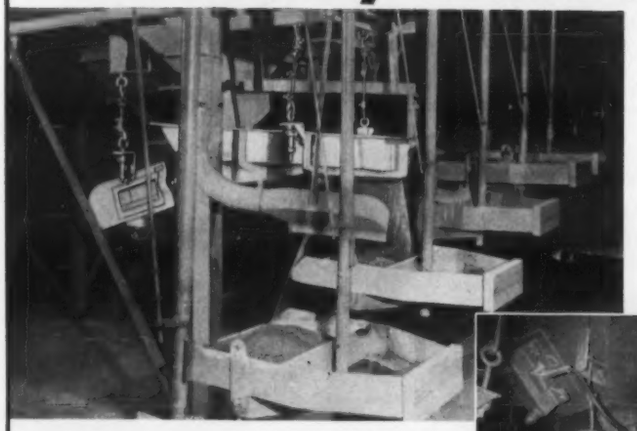
Circle No. 144, Page 7-B

SYNTRON "Vibra-Flow"

Vibratory Feeders



Feeding sand from hopper to conveyor belt.

Feeding tempered foundry sand to pneumatic mold.

add new economy and efficiency to your casting production

SYNTRON Vibratory Feeders provide continuous handling of sand and other bulk materials in foundries all over the country. Combining positive and natural frequency with instant control of vibration, they move sand and other materials—hot or cold—damp or dry smoothly from bins and hoppers to screens, conveyor belts, molds and other process equipment. By maintaining positive control of materials flow any interruptions in the process cycle are eliminated.

SYNTRON Vibratory Feeders are built in a range of capacities with single, dual, twin and twin dual magnets—above or below deck mounting with tubular or flat pan troughs.

Years of experience in the materials handling field qualifies SYNTRON to act on your problems, both large and small.

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Vibrators (bins, hoppers, chutes)	Rectifiers (Silicon and Selenium)
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Vibratory Screens	Electric Heating Panels
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Circle No. 145, Page 7-8

Chapter Meetings

Continued from page 65

Ontario . . Jan. 24 . . Royal York Hotel, Toronto, Ont. . . V. M. Rowell, Harry W. Dietert Co., *"Automatic Sand Control."*

Oregon . . Jan. 15 . . Heathman Hotel, Portland, Ore. . . W. M. Ball, Jr., R. Lavin & Sons, Inc., *"Copper-Base Alloy Foundry Practice."*

Philadelphia . . Jan. 10 . . Engineers' Club, Philadelphia . . H. F. Bishop, Exomet, Inc., *"Feeding Range of Risers—A Review,"* and M. Bock II, Exomet, Inc., *"Exothermic & Insulating Materials Aids to Better Feeding."*

Piedmont . . Jan. 10 . . Hotel Governor Tyler, Radford, Va. . . W. R. Jaeschke, The Whiting Corp., *"Practical Cupola Operations."*

Pittsburgh . . Jan. 20 . . Hotel Webster Hall, Pittsburgh, Pa. . . S. C. Massari, AFS, *"The Gating of Castings."*

Quad City . . Jan. 20 . . Fort Armstrong Hotel, Rock Island, Ill. . . T. Logan, Caterpillar Tractor Co., *"Castings from the User's Standpoint."*

Rochester . . Jan. 7 . . Hotel Seneca, Rochester, N. Y. . . C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., *"Mechanization in the Small Foundry."*

Saginaw Valley . . Jan. 9 . . Fischer's Hotel, Frankenmuth, Mich. . . H. E. Gravlin, Jr., Chrysler Corp., *"Light Metals vs. Ferrous Metals."*

St. Louis District . . Jan. 9 . . Edmond's Restaurant, St. Louis . . R. C. Shannon, Ross C. Shannon & Assoc., *"Your Personality Is Showing."*

Southern California . . Jan. 10 . . Rodger Young Auditorium, Los Angeles . . R. Silva, Fairbanks, Morse & Co., *"Cold-set Cores."*

Tennessee . . Jan. 24 . . Hotel Patten, Chattanooga, Tenn. . . M. E. Annich, American Brake Shoe Co., *"Training for Work Simplification."*

Texas . . Jan. 17 . . Hotel Beaumont, Beaumont, Texas . . C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., *"Mechanization for the Small Foundry."*

Texas, East Texas Section . . Jan. 10 . . Lido Hotel, Dallas, Texas . . T. Brashear, M. B. Parker Co., *"Foundry Costs."*

Timberline . . Jan. 13 . . Oxford Hotel, Denver, Colo. . . H. J. Weber, AFS, *"Legislation Affecting Foundries."*

Toledo . . Jan. 8 . . Heather Downs Country Club, Toledo, Ohio . . R. W. Carlson, Northern Ordnance, Inc., *"Supervisory Responsibility."*

Tri-State . . Jan. 17 . . Western Village Motel, Tulsa, Okla., W. A. Hambley, Charles A. Krause Milling Co., *"Casting Defects."*

Twin City . . Jan. 14 . . Jax Restaurant, Minneapolis . . W. A. Hambley, Charles A. Krause Milling Co., *"Casting Defects."*

Utah . . Jan. 22 . . Central Utah Vocational School, Provo, Utah . . J. A. Comstock, Pratt & Whitney Aircraft Co., *"Engineering Properties of Iron Powder." Joint Meeting with American Society for Metals.*

Washington . . Jan. 16 . . Engineers' Club, Seattle . . W. M. Ball, Jr., R. Lavin & Sons, Inc., *"Copper-Base Alloy Foundry Practice."*

Western Michigan . . Jan. 6 . . Schuler Hotel, Grand Haven Mich. . . E. K. Hatch, Osborn Mfg. Co., *"Automation in Molding."*

Western New York . . Jan. 10 . . Sheraton Hotel, Buffalo, N. Y. . . C. A. Sanders, American Colloid Co., *"Casting Finish Precision of Sand Castings."*

Wisconsin . . Jan. 10 . . Schroeder Hotel, Milwaukee . . *Panel*: W. R. Ellenberger, Nichols Engineering & Rsch. Corp., R. L. McIlvaine, National Engineering Co., and R. K. Strong, Hydro-Blast Corp., *"Sand Reclamation."*

FEBRUARY

Canton District . . Feb. 6 . . Elks Club, Barberton, Ohio . . G. W. Anselman, Whirl Air Flow Corp, *"Handling Sand by Whirl-Air-Flow."*

Central Illinois . . Feb. 3 . . Vonachen's Junction . . N. Demos, General Electric Co., *"Quality Control."*

Central Indiana . . Feb. 3 . . Athenaeum Turners, Indianapolis . . *Panel*: R. Figg, American Foundry Co.; E. X. Wiley, Atlas Foundry Co.; R. Langsenkamp, Langsenkamp-Wheeler Brass Works; B. J. Lavelle, Lavelle Gray Iron Foundry Corp.; R. D. Millhouse, Marion Malleable Iron Works; J. M. Thomas, Sonith Industries, Inc. *Moderator*: A. J Reid, General Refractories Co. *"Know Your Area Foundries."*

Central New York . . Feb. 7 . . Onondaga Hotel, Syracuse, N. Y. . . J. A. Mueller, The Carborundum Co., *"Saving on Snagging & Cut-Off Costs."*

Central Ohio . . Feb. 10 . . Seneca Hotel, Columbus, Ohio . . C. E. McQuiston, Advance Foundry Co., *"Quality Control in the Foundry."*

Chicago . . Feb. 3 . . Chicago Bar Association, Chicago . . *Non-Ferrous & Gray Iron Group*: C. A. Sanders, American Colloid Co., *"Molding Methods Compared"*; *Malleable Group*: R. W. Heine,

University of Wisconsin, *"Controlling Malleable Iron Scrap"; Steel & Maintenance Group*: F. H. Hohn, Scullin Steel Co., *"Vacuum Melting."*

Metropolitan . . Feb. 3 . . Essex House, Newark, N. J. . . J. A. Gitzen, Delta Oil Products Co., *"Chemical & Physical Properties of Cores & Core Washes."*

Michiana . . Feb. 10 . . Club Normandy, Mishawaka, Ind. . . F. B. Rote, Albion Malleable Iron Co., *"Resin Sand Cores."*

Rochester . . Feb. 10 . . Seneca Hotel, Rochester, N.Y. . . H. R. Clauser, Material & Methods Magazine, *"What's New on Engineering Materials."*

St. Louis District . . Feb. 13 . . Edmond's Restaurant, St. Louis . . J. R. Nieman, Shell Process, Inc., *"Shell Mold for Profit in the Small Foundry."*

Southeastern Regional Foundry Conference . . Feb. 20-21 . . Patten Hotel, Chattanooga, Tenn.

Timberline . . Feb. 10 . . Oxford Hotel, Denver, Colo.

Toledo . . Feb. 5 . . Heather Downs Country Club, Toledo, Ohio . R. T. Lewis, Keen Foundry Co., *"Are Your Costs Reliable."*

Twin City . . Feb. 11 . . Jax Restaurant, Minneapolis . . M. Bock, II, Exomet, Inc., *"Exothermic & Insulating Materials."*

Western New York . . Feb. 7 . . Sheraton Hotel, Buffalo, N. Y. . . C. V. Nass, Beardsley & Piper Co.

Mo-Kan . . Feb. 7 . . Fairfax Airport, Kansas City, Kans. . . W. B. Bishop, Archer-Daniels-Midland Co. The Federated Foundry Supply Div., *"Which Core Process."*

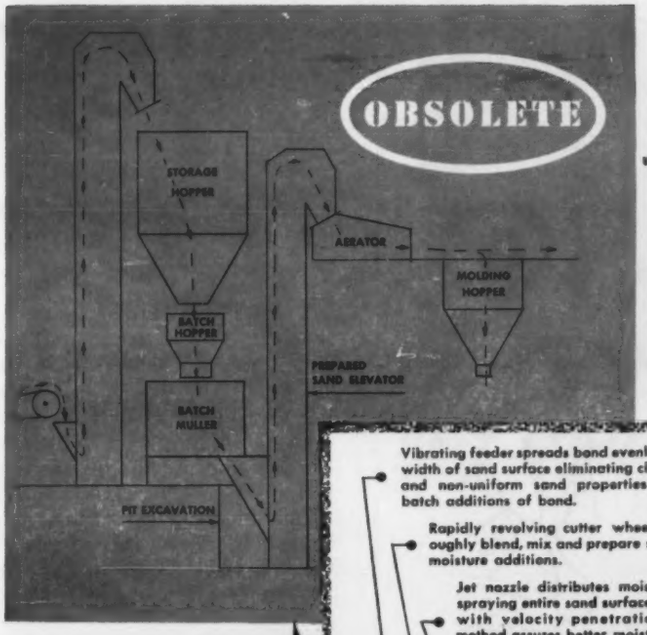
New England . . Feb. 12 . . University Club, Boston . . *Panel*: F. Tibbetts, Wollaston Brass & Aluminum Foundry, Inc., and R. Anderson, Draper Corp., *"Co_2 Core Practice."*

Northeastern Ohio . . Feb. 1 . . Tudor Arms Hotel, Cleveland . . *2d Annual Ladies' Night* . . **Feb. 13 . .** J. F. Roth, Cleveland Standard Pattern Works, *"Developments in Pattern Design & New Materials."*

Northern California . . Feb. 11 . . Spenger's, Berkeley, Calif. . . *Panel*: J. L. Francis, Micro Metals, Inc., and H. von Wolff, Shalco Engineering Co., *"Shell Molding & Coremaking."*

Northern Illinois & Southern Wisconsin . . Feb. 11 . . Lafayette Hotel, Rockford, Ill.

Wisconsin Regional Foundry Conference . . Feb. 13-14 . . Hotel Schroeder, Milwaukee.



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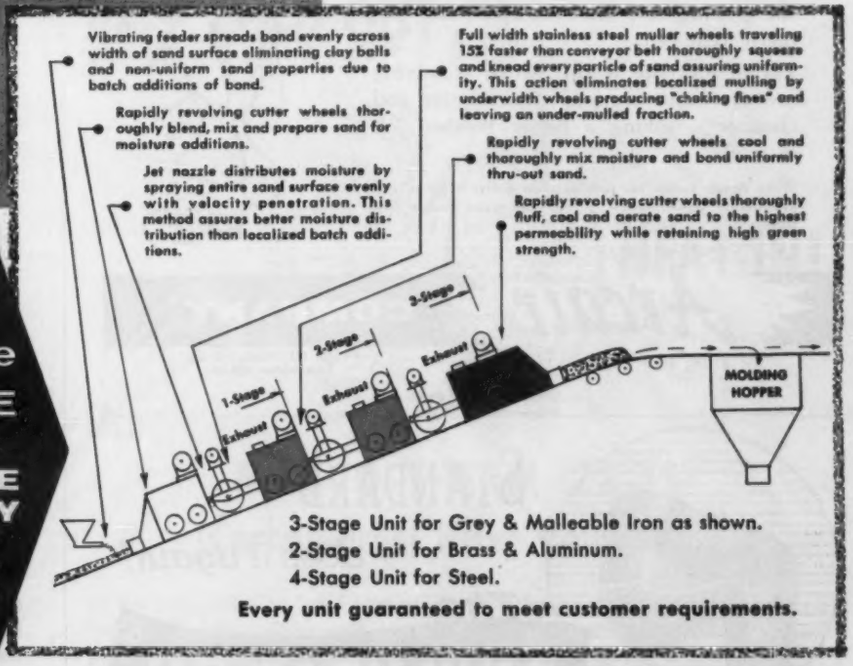
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Rapidly revolving cutter wheels thoroughly fluff, cool and aerate sand to the highest permeability while retaining high green strength.
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2-Stage
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Circle No. 146, Page 7-8

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Circle No. 148, Page 7-8

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Circle No. 149, Page 7-8

Continued from page 31

MOLD AND POURING TEMPERATURES

Casting	Metal	Temperature (F) Mold	Pouring
Wave Guide Cavity	Silicon brass	800	2050
	Aluminum alloy 40E	400	1300
Tapered Transition	Silicon brass	800	2050
	Aluminum alloy 40E	600	1300
70° Tapered-twist Wave Guide Transition	Silicon brass	400	1750
	Aluminum alloy 40E	400	1250
90° Stepped-twist Bend	Silicon brass	800	1750
	Aluminum alloy 40E	400	1250
RF Head	Aluminum alloy 40E	900	1300

ber which exposes only the sprue opening to atmospheric pressure. Without the use of this machine, it would have been very difficult to fill the mold cavity of a thin-walled, heavily cored casting like the RF head. Centrifugal casting could not be used because the fragile cores would have been broken apart by the forces exerted on them.

A torch flame was used to produce a hot top affect on some of the molds to aid in the feeding.

■ Cleaning, Finishing, and Inspecting

After the castings had solidified and cooled, the molds were knocked out by hand. Gates were cut off on a power band saw and castings were smoothed by sanding and filing. Some of the castings were sandblasted. Considerable difficulty was encountered in removing plaster from the cored area of the 90 degree stepped-twist bend, but it was accomplished by using special probes. The castings were given a visual and rough dimensional inspection and turned over to the user for final dimensional checking and electrical performance rating.

■ Results

All castings were checked for electrical performance, regardless of dimensional deviations. This was done for the purpose of studying the effect of these deviations.

The RF head casting was the most difficult one to produce. Through very close control of all process variables, it was possible to produce this casting. The important dimensions were held within the mutually agreed tolerances on all parts. The cored areas of the castings were the important areas. Surface finishes on these areas were 60 to 80 micro in. when the castings were made of aluminum. This is comparable to the extruded tubing used for dip-brazing the assemblies.

The final proof of the investment casting method of fabrication was in the electrical functioning of these castings compared to the same parts fabricated by dip-brazing. Results showed that the castings functioned very well and that electrical data could be reproduced much better from casting to casting than from one dip-brazed assembly to another.

Substantial manufacturing economies are possible by using the investment casting process as a replacement for the dip-brazing previously used for the manufacture of wave guide components. In all cases the design has also been simplified by investment casting. A comparison of dip-brazed parts and investment cast parts is made in the illustration of the 90 degree stepped-twist bend casting. Comparisons of fabricated and dip-brazed parts, and investment cast parts are shown in Fig. 10.

■ Acknowledgment

The authors are indebted to the Department of the Army for permission to publish this paper. The opinions expressed in the paper are those of the authors and are not necessarily endorsed by the Department of the Army. Appreciation is also expressed to Richard P. Palmisano of the Diamond Ordnance Fuze Laboratory for his many contributions toward the success of this program.

■ Based on a paper presented at the Investment Casting Institute Spring Meeting, May 1, 1957, in Washington, D.C.

let's get personal

Stanley S. Davies . . has been elected president of Royer Foundry & Machine Co., Kingston, Pa., succeeding the late S. B. Davies. He was formerly general manager of the firm.

Federal Malleable Co., West Allis, Wis., has reported the election of **Norman N. Amrhein** as president. Mr. Amrhein, president of the AFS Wisconsin Chapter, has been with the firm since 1940. **Carl L. Liebau,** formerly president of the company, has been named chairman of the board. Other promotions were: **Felix Huwiler** to vice-president in charge of sales; **T. F. Slattery** to vice-president and treasurer; **Thomas Teetor** to superintendent; **H. T. Hoak** to plant metallurgist; and **H. L. Wintheiser** to supervisor of technical sales.

Mario Olivo . . Italian foundry technologist has been named Member of Honour of the Verein Deutscher Giessereifachluete in recognition of his efforts to promote international collaboration between foundry scientists. Only one other foreign scientist has ever received this honor.

Pusey & Jones Corp., Wilmington, Dela., has named two new executives. **Elwood C. Conary** has been appointed general superintendent. He was formerly general manager of Genesee Foundry Co., Inc., Syracuse, N. Y. **Paul W. Haynes** has been named chief metallurgist. He was formerly employed by Crompton & Knowles Corp., Worchester, Mass.

Warner B. Bishop, Jr. . . vice-president and manager of Archer-Daniels-Midland Co., Foundry Products Division, Cleveland, has been elected to the board of directors of Archer-Daniels-Midland (Canada) Ltd.

Dr. John F. Thompson . . chairman of the board of International Nickel Co. of Canada, Ltd., will be awarded the Charles F. Rand Memorial Medal for 1958 by the American Institute of Mining, Metallurgical, and Petroleum Engineers.

William C. Miller . . has been named sales manager of National Precision Casting Corp., Reading, Pa. He was formerly sales engineer for Beryllium Corp.

G. L. McMillin . . has been named president and general manager of Canadian Steel Foundries (1956) Ltd. He was formerly vice-president and general manager of Canadian Steel Foundries. **A. C. MacDonald,** former president of the company, becomes vice-chairman of the board of directors.

J. F. Gschwind . . has been named vice-president of development and research for J. O. Ross Engineering Corp., New York. He will have charge of development and research activities concerning Ross air processing systems for foundries.

Almont Mfg. Co., Almont and Imlay City, Mich., has named **Donald D. Bowman** and **Arnold Rogers** as vice-presidents. Mr. Bowman will serve as general manager and Mr. Rogers as foundry manager.

Allen K. Heydrick . . has been named to the new post of education and training director for Link-Belt Co., Chicago. The position has been established to coordinate and emphasize the company's education, training and employee development programs.

Seymour B. Donner . . has been named plant manager of Deemer Steel Casting Co., New Castle, Dela.

H. M. Brownrigg . . has been elected vice-president of Joliette Steel Div., Dominion Brake Shoe Co., Joliette, Que. He was formerly works manager.

J. W. Luoma . . has been appointed technical assistant in the Chicago office of the roll sales dept., Blaw-

Continued on page 70

M. Olivo

P. W. Haynes

W. C. Miller

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Circle No. 130, Page 7-8

Lets ' Get Personal

Continued from page 69

Knox Co., Pittsburgh, Pa. He was formerly manager of metallurgy in the foundries of Continental Foundry & Machine Co., recently purchased by Blaw-Knox.

C. E. Davies . . has retired as secretary of the American Society of Mechanical Engineers. He is succeeded by O. B. Schier, II.

Dr. Alexander Silverman . . Professor Emeritus of Chemistry, University of Pittsburgh, will receive the 1958 Albert Victor Bleininger Award of the American Ceramic Society.

Walter W. Goehring . . has been named manager of the manufacturing department, F. J. Stokes Corp., Philadelphia.

Ernest M. Knapp . . president of Ferro Machine & Foundry, Inc., Cleveland, has been elected to the board of directors of Gale Mfg. Co., gray iron foundry at Albion, Mich.

J. R. Vogt . . has joined Electro Metallurgical Co. as a service representative in the non-ferrous section of the Cleveland office. He was formerly employed as plant metallurgist, Castings Div., Bohn Aluminum and Brass Corp.

Robert F. King . . has been appointed superintendent of Bridgeton Foundry, Bridgeton, N. J. He was formerly superintendent of the Watson Co., Bowie, Md.

Abraham S. Hottel, Jr. . . has been elected assistant treasurer of Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

Thomas D. West . . has been appointed manager of shop operations for the Everett steel foundry of General Electric Co.'s Foundry Dept.

Gordon W. McIntyre . . has been elected president of Welland Iron & Brass Ltd., Welland, Ont.

Arnold J. Martin . . has been appointed vice-president of Samuel Greenfield Co., Buffalo, N. Y. He was formerly manager of sales and advertising.

Kenneth W. McGrath . . has joined the foundry consulting staff of Metallurgical Associates, Inc., N. Y. as a specialist in ductile iron. Mr. McGrath was formerly foundry manager for the Hunt-Spiller Mfg. Corp., Boston.

Paul C. Holland . . has been named general manager of the National Precision Casting Corp., Paoli, Pa.—subsidiary of Beryllium Corp. in Reading, Pa. Mr. Holland was the former product manager of the Beryllium Corp.

Charles Reynolds . . Associate Professor of Metallurgy at M.I.T. has accepted the position of Assistant Dean of Engineering at Dartmouth College.

L. J. Venne . . has joined Electro Metallurgical Co. as a service representative in the foundry section of the Cleveland office. He was formerly employed by American Steel Foundries.

Thomas E. Gregory . .is now metallurgical engineer for Western Electric Co., Winston-Salem, N. C. He was formerly on the Research Center staff, American Smelting & Refining Co.

Paul Fischer . . has been named manager of the Hyster Co. Portland Ore., plant.

National Carbon Co. Div., Union Carbide Corp., has announced new assignments in its electrode products organization. **James King, Jr.,** has been named sales manager; **J. M. Schreiner** has been named central division manager; and **M. M. Rand** has been appointed as Pacific division manager.

J. S. McVey, Jr. . . has been appointed casting design engineer for the Everett-Lynn foundries of General Electric Co.'s Foundry Dept.

Arthur T. Baum . . has been named director of industrial relations for Unitcast Corp., Toledo, Ohio.

N. A. Spector . . has been named a director of Zirconium Corp. of America, Solon, Ohio.

Lehigh Foundries Co., Div. of Lehigh, Inc., Easton, Pa., has named new officers. **R. W. Crannell** has been elected president, **Hans Jacob** and **H. W. Streeter** vice-presidents, and **F. C. Krauss,** treasurer.

J. A. Lang . . has been named assistant to the vice-president in charge of manufacturing for Crane Ltd. He

J. A. Lang

was formerly manager of Crane's Warden King, Ltd. Div., Montreal, Que.

James L. Yates . . has been appointed chief foundry engineer for the Crane Co., Chicago.

Wylie I. Childs . . formerly professor of metallurgical engineering, Lafayette College, has been named associate professor of metallurgical engineering at Ricketts Laboratory, Rensselaer Polytechnic Institute located at Troy, N. Y.

Charles A. Schulte . . has been named manager of the Vanadium Corp. of America Vancoram Plant at Vancoram, Ohio.

M. L. Slawsky . . has been appointed to the development engineer-precision pilot plant for the Applied Research & Development Laboratory of the General Electric foundry department.

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Circle No. 151, Page 7-8

dietrich's corner

by h. f. dietrich

Shift to Education Spells End to Yesterday's Rough, Tough Foreman

The successful foreman of today would have been a failure in yesterday's world. The requirements of foremanship have changed. With these changes have come a demand for a man of different characteristics.

The foreman of the turn of the century was an extrovert—often, a loud-mouthed bully. He could line a furnace, pour off a heat, or make the most difficult mold better than any man under his supervision. Profanity and fighting skill were his diplomatic weapons. If this hard drinking autocrat ever found himself unable to do the physical labor of two men, he was dethroned in favor of a stronger man. Strength was king.

Workmen refused to work for anyone they could whip. Education was resented in the working ranks, and emphasis was placed on the self-made man who had pulled himself up by his boot straps.

This attitude of the workers is understandable if we remember that most of the workers of that time were immigrants only a short step from serfdom. Their command of English was limited, and the only power they understood was force which is the same in any language.

With the end of World War I, a new labor force came into being, and with it grew the demand for a new type of foreman. Emphasis was placed on manual skill rather than physical strength. A foreman could demand respect if he were capable of constructing a rolling cheek mold, or if he could ram a mold to prevent a buckle on a flat casting.

Education was acceptable, but not required of a skilled mechanic. The hierarchy of skill reached into the labor ranks. This resulted in a caste system in which the pit molder was of highest cast and the shakeout man was an untouchable. Shop policy could be determined on a political basis. Trade unionism and foreman favoritism worked together in an attempt to freeze this caste system into tradition.

The success of a foundry depended to a great degree upon the skill of its workers because of the large human element involved in casting. A foreman would take pride in the skilled men he could gather around him. Jobs would be assigned to certain men. If the man decided to take a lost week end, the job would wait his return. Except for apprenticeships, job training was practically unknown. Men of certain skills were hired for the job. The result was the itinerant molder who traveled from shop to shop picking up more skill in the process.

World War II demanded production at a rate unknown before. Business could not tolerate the prima donna of the slick and trowel. Whether the man appeared for work or not, the job had to go on. Patterns had to be designed for the unskilled, but better educated, working force. Emphasis shifted from manual skill to education. Engineers and production control men were introduced to design work and methods for a work crew of limited experience. A cost-conscious industry began to recognize the price paid for high labor turnover and demanded a foreman who could keep work on schedule.

The ideal foreman of today would require the strategic ability of Alexander, the diplomacy of Churchill, the financial ability of Mellon, the patience of Job, and the wisdom of Solomon. With all of these, he still would have been unsuccessful with the working force of yesterday unless he had the fighting ability of Sullivan and the skill of da Vinci.

Educated workmen cannot be browbeaten into submission. The old-timer could not be awed by book knowledge. Therefore, foremen of different types would be required for the two periods in time. The rough and ready driver for yesterday, and the educated diplomat for today. They could not exchange places. The present day foreman would not fit into yesterday's world.

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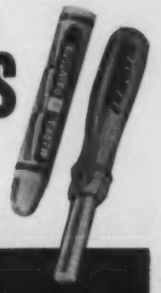

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Circle No. 152, Page 7-8

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Circle No. 153, Page 7-8

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Circle No. 154, Page 7-8

foundry trade news

Archer-Daniels-Midland Co. . . . Cleveland, has announced that the Federal Foundry Supply Co., Cleveland, has been dissolved as a corporation and is now a division of Archer-Daniels-Midland.

In addition, the company has dropped the Foundry Products Div. name of Archer-Daniels-Midland, and the name is now combined as Archer-Daniels-Midland Co. The Federal Foundry Supply Div.

Pennsylvania Malleable Iron Corp. . . Lancaster, Pa., has opened its new plant, said to be the first completely new jobbing malleable iron foundry built since World War II. The plant is a one story structure, approximately 35,000 sq ft, and completely equipped with the latest in melting, sand handling, and cleaning machinery to produce malleable iron castings up to 25 lb.

Located near Lancaster, the new plant is directed by Thomas M. Blank, vice-president and manager of manufacturing of the Pennsylvania Malleable Iron Corp.

Superior Steel & Malleable Castings Co. . . . Benton Harbor, Mich. has completed expansion of its main office building to include a modern drafting room and engineering department with a stress laboratory; physical and chemical laboratories with facilities for gamma ray photography; an enlarged woodworking shop for pattern mounting, repair, and alteration; and additional offices, conference room, and employee locker and rest rooms.

Superior has been producing quality castings since 1916, and today produces a wide range of alloy steel castings through 30,000 lb and certified malleable iron castings through 300 lb.

Foundry facilities and techniques used to produce castings up to 5500 lb on display by the Metals Processing Div., Curtiss-Wright Corp. The company's exhibit, "Tomorrow's Metals Processing Today," was recently staged at the Waldorf-Astoria Hotel, New York City.

Pusey & Jones Corp. . . . Wilmington, Dela., was purchased in October by a group of businessmen headed by Joseph B. Ulicny, New Brunswick, N. J. The 109-year-old foundry's activities include manufacture of papermaking machinery, metals fabrication, and shipbuilding.

New Jersey Zinc Co. . . . New York, received first prize in the 1957 *American Metal Market* annual marketing awards for sales promotional activities in the die casting industry. The company's program was judged best in the copper, lead, and zinc category.

Howard Foundry Co. . . . Chicago, has conducted their five-day Casting Engineering and Production Course for 276 engineers, buyers, casting coordinators, tool engineers, etc. in the past two and one-half years.

The course covers design engineering and production of castings; metal dies, and wood and metal pattern equipment; metallurgical characteristics of magnesium, aluminum, brass, ductile iron, alloy iron, and steel alloys; and quality control procedures, why and when they are used. Four days are spent in the company's Chicago plants; Magnesium Div., Pattern Shop Div., Aluminum and Brass Div., Machine Shop Div., and Alloy Steel and Iron Casting Div. One day is spent in the Milwaukee Investment Casting Div.

Gaines Co. . . . Rivera, Calif., has announced that scrap losses were cut from 30 to 40 per cent through installation of x-ray inspection. Sample castings are taken off the production line every two hours for inspection. Ten per cent of the foundry's castings

Ten per cent of all castings are inspected by x-ray at Gaines Co.

are x-rayed, and the line forman receives a report in 15 minutes.

If the x-ray shows castings to be defective, the line is shut down until the trouble is cleared up. Reject rate on finished work is less than five per cent, low for the light metals industry.

Bennett-Ireland, Inc. . . . Norwich, N. Y. solved the problem of producing an all brass fireplace andiron of intricate detail with shell molding. Control of wall thickness, reduced finishing operations and ability to hold small and intricate detail were the determining factors which led to shell molding. Shalco dump-type machines were used to produce inner contours, the four outer inter-locking cores

Andirons being poured from yellow brass in Bennett-Ireland's foundry.

(which produce tracery design) and the outer contour of the part. This process held flash to a minimum, finishing operations substantially reduced, wall thicknesses strictly controlled and more rapid production resulted. In many cases the casting was ready for polishing after sawing the gates.

Brush Beryllium Co. . . hosted 300 guests at the formal dedication of the company's new beryllium metal plant at Elmore, Ohio Nov. 18. Guests

Senator Bricker, Ohio, tours plant.

included officials of U. S. Government agencies, civilian customers, directors, local civic leaders, and a group of employees. The new plant produces vacuum-cast ingots at the rate of 10,000 lb per month.

Prospects good for 1958 . . for the American Steel Foundries in spite of the fact that backlog of unfilled orders has been dropping slightly. Joseph Lanterman, vice-president of the company told the Cleveland Society of Security Analysts that while the

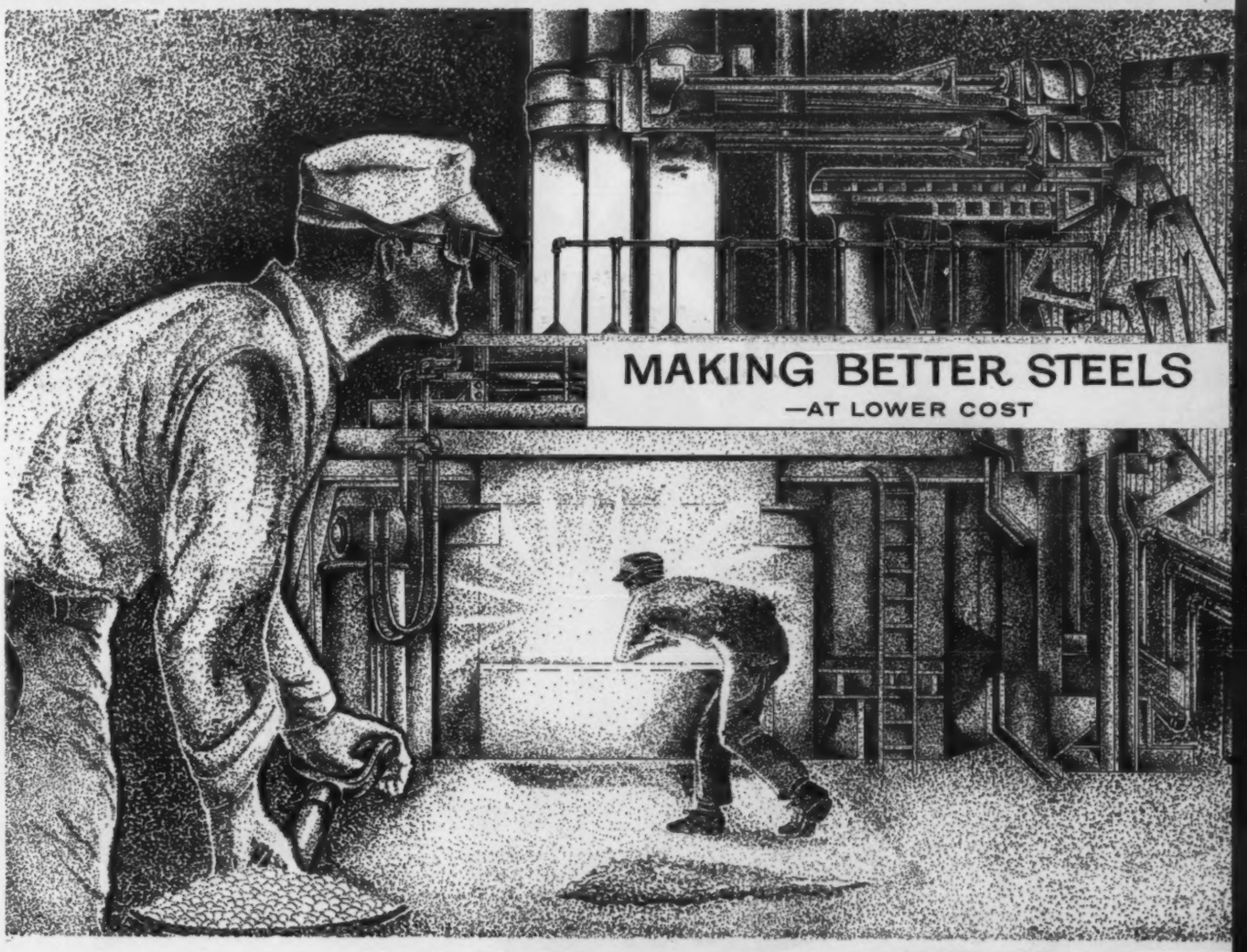
53,000,000 backlogs as of Sept. 30, 1957 is $9,000,000 off the total at the start of the year, it is sufficient to offer a basis for predicting that earnings for the first six months of fiscal 1958, ending in March 31, will equal the average shown for the past fiscal year.

He called attention to the company's diversification activities which resulted in an increase of sales to non-railroad customers equaling 40 per cent of total sales as compared to 10 per cent ten years ago. This shift came about through acquisition of non-rail lines; and expansion of foreign activity with affiliates in Mexico, Brazil, Argentina, and Australia.

Carborundum Co. . . Niagara Falls, N. Y., has announced that the company's Stupakoff Div., Latrobe, Pa.; Globar Div., Niagara Falls, N. Y.; and Refractories Div., Perth Amboy, N. J., will be integrated into one division, the Refractories Div.

Claude B. Schneible Co. . . Detroit, has announced association with W. Thomas Barr Associates, Birmingham, Ala., and R. F. Kleinfeldt, Cincinnati.

Young ideas and new equipment are competitive weapons for long-established firms, as well as for newer companies. Cowboy Frederic Claghorn, Jr. is riding a new sand slinger installed as part of a $100,000 modernization program at Fletcher Foundry Div., Fletcher Works, Inc., Philadelphia. Anxious grandfather is Edward T. Taws, president of the company. The young man's father, F. S. Claghorn, is vice-president of the operation. New sand preparator and muller have also been added at this gray iron shop. Formerly a straight captive operation, the foundry now sells 90 per cent of its production.



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Circle No. 156, Page 7-8

FOUNDRY CORE PRACTICE

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Circle No. 157 Page 7-E

Niagara Regional

Continued from page 63

maker must impress upon apprentice pattern makers the importance of proper construction and handling.

■ **Steel.** For the lead-off steel session, Clyde B. Jenni, General Steel Castings Corp., Eddystone, Pa., described *"Steel Castings to Compete with other Materials."* The basis upon which the steel castings should compete, he stated, is engineering characteristics. "The engineering characteristics of steel castings have enabled them to assume great economic importance in the modern economic structure," Mr. Jenni said.

Russia is well-informed of advances made by our foundry technologists, according to A. J. Kiesler, General Electric Co., Schenectady, N. Y., who spoke on the **"Russian Foundry Industry."** He noted that AFS publications are translated and available to Russian scientists within months of their initial publication in the U. S. He also commented on Russia's ability to concentrate the efforts of its scientists on finding the solution to any particular problem.

In the final steel session, J. A. Gitzen, Delta Oil Products Co., Milwaukee, traced the historical development of sand additives in his talk on *"Core and Molding Sand Additions."* He remarked that the trend in development of sand additives has been toward the use of less water, because excessive moisture causes trouble in molding and coremaking.

■ **Gray Iron.** Simplicity of pneumatic sand reclaimation installations was stressed in a talk on *"The Development of Pneumatic Sand Reclaimation"* presented for gray iron foundrymen by Clifford E. Wenninger, Beardsley & Piper, Div. Pettibone Mulliken Corp., Chicago.

Costs of operating and maintaining pneumatic systems compare favorably with costs reported for wet reclaimation systems, according to Mr. Wenninger. He also noted that sub-angular base sand requires almost twice as much scrubbing as round-grain base sands of like distribution analyses; and that sand finer than AFS Efn 65 should be considered as akin to sub-angular sands because of total mass surface area requiring additional scrubbing during processing.

The mysteries of cupola operation are merely the result of failure to tighten control of controllable variables in melting. This conclusion was reported by W. L. Adams, Eastern Clay Products Dept., International

Minerals & Chemicals Corp., Chicago. Basic variables must be brought under control, he stated, before "unaccountable" variations in cupola operation can be eliminated.

Anton Dorfmueller, Jr., Archer-Daniels-Midland Co., Cleveland, presented a talk on *"Which Core Process"* in which he discussed the advantages and disadvantages of the four major processes for making cores: conventional, shell, air-setting, and gas setting. The best core is the cheapest one that does the job efficiently, he stated.

■ **Malleable.** Two opportunities to employ common sense were shown by Earl E. Woodliff, consulting engineer, Detroit, in his talk on **"Fundamentals of Sand Control."** He noted that control is essentially a matter of using good sense, but the person responsible for control must be familiar with the effect of mechanical processing on the behavior of sand. Another area in which to follow good sense is in the development of science of sand use which is often retarded by the tendency to follow accepted practices.

■ **Non-ferrous.** Control of pinhole porosity in bronze castings was the goal of an investigation reported by R. B. Fischer, Ingersoll-Rand Co., Phillipsburg, N. J., in his paper on *"Metal-Mold Reaction in Bronze Alloys."*

The metal-mold reaction has been established as a source of pinhole porosity in 85-5-5-5 and composition "M" bronze poured in oil-bonded dry sand molds, Mr. Fischer reported. Metal composition and molding sand binders were found to be controllable variables important factors in eliminating pinholes. Pitch used as a binder for dry sand molds or as an additive to green synthetic sand eliminates the pinholing of 85-5-5-5 metal, Mr. Fischer's study revealed.

Special mold and core coatings were reported to be effective in reducing pinholing.

"New Alloys and Methods in the Foundry," were described to the nonferrous audience by Joe Allen, Federated Metals Co., Newark, N. J. Problems and potential markets for castings of zinc, zinc-aluminum, lead, tin, and fusible alloys were outlined for shops now concentrating on brass and aluminum production.

Donald L. La Velle, Federated Metals Div., American Smelting & Refining Co., South Plainfield, New Jersey, closed the non-ferrous sessions with *"Gas and its Control in Aluminum Alloy Castings."*

Mr. LaVelle said the only gas alu-

Continued on page 76

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Man on the left claims that Tru-Steel does the best cleaning job at lowest cost. Fellow on the right swears by Malleabrasive. But they're *both* right! Tru-Steel is best on some jobs . . . Malleabrasive is best on others. Different jobs may call for different abrasives but the result should always be the same—the best job at lowest cost per ton of castings cleaned.

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Circle No. 158, Page 7-8

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Niagara Regional

Continued from page 75

minum foundrymen need be concerned with is hydrogen, which is derived from reaction of molten aluminum with water or water vapor from products of combustion, humidity in the air, moist metal charge, tools, or fluxes. He said hydrogen is soluble in molten aluminum, but essentially insoluble in solid metal; causing porosity or pinholes in castings. Overheating accentuates porosity.

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Purdue Regional

Continued from page 63

is put into production becomes an average job, the total scrap is thus brought under control. The foundation for effective control is contained in four basic steps: 1) collect pertinent data, 2) pinpoint problems, 3) investigate causes, and 4) take corrective action.

Modern Green Sand Molding

Four modern green sand molding techniques were described in a special symposium by four speakers.

■ **Diaphragm Molding**—William Cheek described the Central Foundry Division, GMC, installation at Danville, Ill. A film of the operation showed how they were able to produce 252 molds per hour with less manpower. Although need for heavy foundations is eliminated, stronger flasks are needed to withstand the pressure exerted on the sand by the diaphragm.

■ **Stack Molding**—George Miller, San Blo Div., Archer-Daniels-Midland Co., Cleveland, described equipment used to rapidly blow-squeeze molds for a stack-molding operation.

Mr. Miller defined stack molding as a method of closing or assembling mold sections in a vertical plane so that more than one gate of castings is fed and poured from one common sprue. Among advantages attributable to stack molding are less pouring time, shakeout time, floor space, weight shifting, and manhours per casting.

■ **Jolt Squeeze**—C. H. Lambert, Eberhard Mfg. Co., Div. of The Eastern Malleable Iron Co., Cleveland, described one of the most highly automated jolt-squeeze installations in the country.

By substituting 150 air and hydraulic cylinders for human muscles and 250 electronic circuits for human minds, an output rate of 600 molds per hour has been achieved. Maintenance costs $0.0025 per mold.

■ **Sand Slinger**—William E. Patterson, Elkhart Foundry & Machine Co., Elkhart, Ind., described his plant's experiences with sand-slinger operations. The speaker commented on versatility of their equipment, which could be moved to large molding jobs or remain stationary and have small flasks delivered to it for ramming.

Carl Joseph, Central Foundry Div., GMC, spoke on the subject of *"Hot Blast and Moisture Control."* In his experiences with a 400 F cupola blast he found increases in melting rate, temperature of iron at the spout, and

Continued on page 78

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modern castings

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Circle No. 160, Page 7-8

Make Iron Ductile with Magnesium Ferrosilicon

Mg

The microstructures shown at the right illustrate how an addition of magnesium converts flake graphite to a spheroidal type and is the key element in the production of "ductile" or "nodular" iron. An economical and convenient source of magnesium for these irons is ELECTROMET magnesium-ferrosilicon. This ladle-addition alloy can be added to iron made in either the cupola or electric furnace and is available in three grades, including 0.5 and 2 per cent cerium-bearing grades. Cerium neutralizes certain elements which inhibit the formation of spheroidal graphite. All three grades contain 1.00 to 1.60 per cent calcium which intensifies the spheroidizing action of magnesium.

To obtain the best combination of ductility and freedom from chill in light sections, the magnesium-ferrosilicon addition is usually followed by a post inoculation with ferrosilicon. ELECTROMET calcium-bearing 85 per cent ferrosilicon is an improved grade used by many ductile iron foundries.

For further information and technical assistance, contact ELECTROMET, supplier of alloys for gray, ductile, and malleable iron.

ELECTRO METALLURGICAL COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Electro Metallurgical Company, Division of Union Carbide Canada Limited, Toronto.

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Note in the top micrograph how the graphite flakes break up the continuity of the gray iron matrix, causing low strength and brittleness. In the bottom micrograph, the addition of a small amount of magnesium has changed the graphite structure from flake to the spheroidal type which has less effect on the continuity of the matrix. This "ductile" or "nodular" iron structure is therefore stronger, tougher, and more ductile.

Electromet
FERRO-ALLOYS AND METALS
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NOTE: Since patents cover the use of magnesium in the production of ductile iron, we suggest that you investigate how these patents might affect you.

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Purdue Regional

Continued from page 77

thermal efficiency. Marked decreases appeared in coke consumption, oxidation of alloying elements, sulphur pickup, misruns, and hot tears.

"Hot Tearing" was the subject of a talk by Richard W. Heine, Assoc. Prof., University of Wisconsin, Madison, Wis. According to the speaker, most hot-tear problems result from normal metal contraction combined with one of the following factors: feeding of casting, mold and molding sand stability, cores, casting design, and miscellaneous causes. How to recognize cause of tears and correct the unfavorable conditions was outlined.

"Ductile Iron" has come a long way in 9 years to establish itself as an important cast engineering material, according to a talk by Eric Weilander, chief metallurgist, Deere & Co., East Moline, Ill. Mr. Weilander outlined the metallurgy of cupola melting with basic slag and current innoculating procedures.

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memo

To: Modern Castings Readers

From: the Editor

For two and a half years MODERN CASTINGS has been bringing to its readers a special monthly Bonus Section devoted to some important phase of foundry operations. Every alert man of the metalcasting industry should have copies of these invaluable technical papers in his reference file.

Realizing the inherent worth of this material MODERN CASTINGS has grouped the Bonus Sections according to major interests and is offering them at special prices. The entire collection of 24 Bonus Sections, comprising 384 pages, has been combined into one attractively covered volume and is being offered for the first time at a price of $10. A complete listing of the Bonus Sections, by subjects, follows. Prices for single copies, for groups, and for the total collection are shown.

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modern castings

FOUNDRY FACTS NOTEBOOK

Metallurgy of Gray Cast Iron

Part 1: What Causes Graphite Formation

BY C. H. MORKEN
Vice President and Works Manager
The Kennedy Valve Mfg. Co.
Elmira, N. Y.

FOUNDRY FACTS NOTEBOOK *is designed to bring you practical down-to-earth information about a variety of basic foundry operations. As the name implies, this page is prepared for easy removal and insertion into a notebook for handy future reference.—Editor.*

Fundamental Reactions in Gray Iron

3 Fe (iron) + C (carbon) = Fe_3C (combined carbon)

Fe_3C + Heat = 3Fe + C

Fe_3C + Slow Cooling = 3 Fe + C

Fe_3C + Si (silicon) = 2 Fe + FeSi (iron silicide) + C

2 Fe_3C + 3 Si (optimum amount) + Optimum Cooling Rate = Fe_3C + 3 FeSi + C = Optimum Structure

Any discussion of the technicalities of gray iron is more than likely to be confusing to non-metallurgists because cast iron is one of the most intricate and complex of all metals. The chemistry of its behavior is a deep and involved subject. Discussions of cast iron are bound to include reference to cementite, pearlite, ferrite, austenite, critical temperature, and graphitization rate.

These are all words dropped in a confusing tangle when metallurgists get together. It is the purpose of this discussion to explain in simple words what takes place inside a piece of cast iron while it is solidifying and cooling in the mold, and to explain the factors that conspire to create the properties by which gray cast iron is recognized.

In some ways cast iron is similar to steel, fundamentally an alloy of iron and carbon. By itself, iron is a very soft and ductile metal. When it is combined with carbon, its strength and hardness increase. Furthermore, the iron-carbon alloy that is formed responds to heat treatment; that is, it can be hardened or softened by various thermal treatments. Generally speaking, the higher the carbon, the greater will be the hardness and strength.

In steel, the carbon is usually all combined—that is, tied up chemically with the iron as an alloy. When you fracture a piece of ordinary steel you cannot see any carbon, even with a microscope. In steel, the normal carbon range is from about 0.05 to 1.5 per cent.

In cast iron, only a small portion of the carbon is combined and the rest appears as graphite, also called graphitic carbon. The carbon is much higher in cast iron than it is in steel. The useful range is from about 2.75 to 3.8 per cent. Most of the cast iron produced will run in the range of about 3 to 3.6 per cent carbon.

Therefore, cast iron is characterized by its content of a large amount of carbon, part of which may be, and usually is, chemically combined with the iron; but most of which is present as free graphite.

Another element, silicon, also enters the picture. Present in ordinary steel in negligible amounts (usually less than 0.2 per cent), it is common for cast iron to contain from about 0.75 to 3 per cent of the element.

Silicon has the remarkable and useful property of forcing the combined carbon out of solution in iron, breaking up the chemical combination of carbon and iron. When it is thus divorced from its marriage with iron, the carbon separates out as graphite. A little silicon causes only a little graphite to form; a lot of silicon promotes the formation of a lot of graphite, all other things being equal.

Large graphite produces low engineering properties. X175.

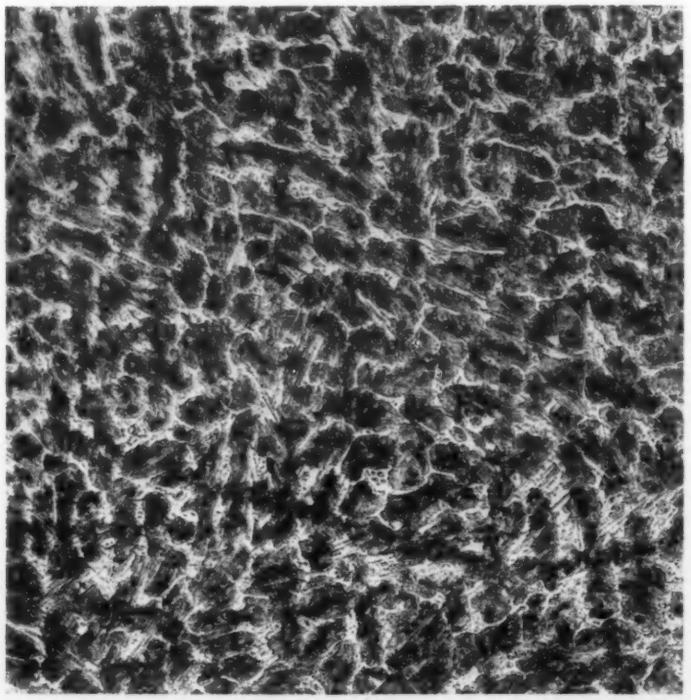
Pearlite matrix plus graphite in normal gray iron. X1800.

Temperature enters into this silicon-graphite relationship also. All chemical reactions work fastest when hottest. Thus, the higher the temperature, up to the melting point, the faster the silicon works; and the more rapid is the graphitization action. Conversely, as the metal cools off, less and less graphite is formed, until at about 800 F the reaction substantially stops and no more graphite is formed.

Summary and Conclusions

1. Cast iron is characterized by its relatively large carbon content, usually some 3 to 3.5 per cent.
2. A small part of this carbon is chemically combined with iron, as in steel.
3. The major portion of the carbon is present as free graphite.
4. Cast iron also contains from 0.75 to 3 per cent silicon, depending upon the kind of castings being made.
5. Silicon causes graphite to be liberated from its chemical combination with iron.
6. The higher the silicon content, the more graphite will be formed.
7. The slower the mass of metal cools, the more graphite will be formed.
8. If the silicon content is high enough, and the metal cools slowly enough, the combined carbon may be entirely decomposed so that all the carbon will be present as graphite. This is often the case with pig iron.
9. Conversely, if the silicon is low enough and the metal cools fast enough, no graphite will form; and all the carbon will be present as combined carbon. This is the state of white iron, used to make malleable iron; it is also the state in the outer layer of chill-cast iron, such as car wheels and brake shoes.
10. For any given casting with a certain cooling rate in the mold there is a correct amount of silicon. If it is too high, too much graphite will form, too little combined carbon will be left, and casting will be too soft. If it is too low, too little graphite will form, too much combined carbon will be left, and casting will be too hard and brittle.

■ *Presented at clinic sponsored by Metallurgical Associates, Inc., New York.*



White iron. X200. White areas are primary cementite.

memo

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the SHAPE of things

safety, hygiene, air pollution

by HERBERT J. WEBER

A Volkswagen or Cadillac

Frequently we receive inquiries about the cost of dust collection equipment for cupolas. Those are always tough ones to answer because it is equivalent to asking how much an automobile costs. A Volkswagen will give more miles per gallon than a Cadillac, but it doesn't have the Cadillac's horsepower—among other things. So with dust collectors!

Here are some basic factors influencing costs of dust collectors:

1) *Price Versus Capacity*

The larger the collector required the higher will be the cost, but the cost per cubic foot of gas handled per minute (cfm) will be less for the larger collector, just as one 4-horsepower motor will cost less than two 2-horsepower motors.

2) *Efficiency*

The higher the efficiency required by air pollution ordinances, the greater will be the cost of equipment. This is particularly true if it is necessary to collect the very fine particles.

3) *Accessories Included*

In some cases, the price quoted may not include all the equipment necessary for the complete installation, such as:

A) Fan, motor, drive and starter
B) Supporting structure
C) Dust storage hoppers
D) Duct connections
E) Recirculating water pumps and/or settling tanks
F) Factory pre-wired operating control panels.

4) *Installation Cost*

Installation may cost almost as much as the collector itself. Collectors may be shipped completely assembled, sub-assembled or completely knocked down. There may be need for extensive electrical work, or water and drain supply. These costs vary with the local plant situation.

5) *Special Construction*

The installation may require high temperature cooling equipment, corrosion-resisting materials, and weather protection for outdoor installations.

6) *Dust Disposal*

After dust is collected, it must be disposed of. With dry collectors, collected material can be discharged through dust gates, trickle valves, rotary locks or screw conveyors to tote boxes, trucks or continuous material-handling equipment. With wet collectors, remote settling tanks may be used. Dewatered material may be disposed of by continuous material-handling equipment.

7) *Water Supply*

In the case of wet collectors, if water is expensive in your area, it may pay to recirculate. The cost of recirculation equipment should be considered as part of the installation.

8) *Law*

Furthermore, when choosing a collector that will satisfy an existing air pollution ordinance, what happens if the ordinance later becomes more stringent? You have three choices:

- Scrap the existing equipment if it cannot be used as a primary separator for a more efficient collector.
- Buy initially a piece of equipment suitable for an existing ordinance but which can be used later as a primary separator.
- Buy initially a collector efficient enough to satisfy the most stringent anticipated law.

These factors determine whether you want a Volkswagen or a Cadillac.

New Alloy Makes Stronger Castings for Automobiles

■ A new casting alloy, 88M Armasteel, has been developed by Central Foundry Div., General Motors Corp. to make stronger castings for the automotive industry. Because of its hardness, (Brinell range 269-302), the metal has good wear resistance and high yield strength; and still retains good machining characteristics.

The new metal is designed to relieve customer heat treating facilities and eliminate the cost of the heat treating operation. Pearlitic malleable iron is gaining in importance in the castings field because stronger castings are needed for the increased power of modern automobiles.

New testing methods such as stress analysis, cobalt 60 radiography, and sonic testing are enabling foundry engineers to replace forgings, stampings, and weldments with stronger castings at less cost. Automotive applications for the new alloy include universal joint yokes, transmission output shafts, and diesel engine gears.

GOT MELTING PROBLEMS?

Solutions to gray iron foundry problems often come easier to outside consultants. To get expert help, call a Semet-Solvay metallurgist . . . he's a practical foundryman whose job it is to help you.

The high uniform quality of Semet-Solvay Foundry Coke plus expert help from our metallurgist will solve your cupola problems.

SEMET-SOLVAY DIVISION
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For Better Melting

Circle no. [illegible], Page [illegible]

casting through the ages

According to an article
PUBLISHED NOVEMBER 1798, AN ARAB OF CONSTANTINOPLE HAD DISCOVERED A METHOD OF CASTING IRON WHICH, WHEN IT CAME OUT OF THE MOLD, WAS A MALLEABLE AS HAMMERED IRON! AN ANALYSIS OF HIS SAMPLES SHOWED NO MIXTURE WITH OTHER METALS. THIS OBSCURE CRAFTSMAN, IT APPEARS, HAD DIED IN POVERTY AND HIS SECRET HAD PERISHED WITH HIM.
ONE OF THE ORGANIZERS OF AMERICA'S FIRST IRON FOUNDRY AT SAUGUS, MASSACHUSETTS IN 1642, WAS THOMAS DEXTER, GREAT-GREAT-GRANDFATHER OF THE FAMOUS REVOLUTIONARY PATRIOT AND POST-REVOLUTIONARY BRASS AND IRON FOUNDER—
PAUL REVERE.
IN ADDITION TO CASTING PIPES AND SLING SHOT PELLETS FROM LEAD, THE ANCIENT USED THIS MATERIAL FOR MAKING ARROW HEADS, TOYS, ROOFS AND BATH TUBS!
Odd Bits
Until THEY BEGAN CASTING GEAR WHEELS FROM MACHINE-MADE MOLDS, ABOUT 1860, BRITISH MANUFACTURERS COMMONLY USED STOCK PATTERNS THAT FREQUENTLY HAD BECOME WARPED OR SHRUNKEN.

For Finer, Faster Castings

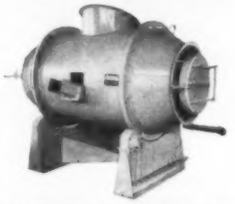
STROMAN FURNACES

Melting Brass, Bronze, Aluminum, Magnesium or any other non-ferrous metal? Are you Sand Casting, Die Casting, Billet Casting, Permanent Molding, Extruding or Forging? If so, Stroman is your natural source for melting furnaces . . . for Stroman builds only the finest, fastest melting, most economical, longest lasting and of course the most modern furnaces to melt any metal.

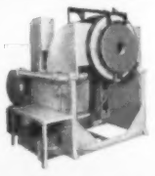
Illustrated are just a few of the various models available. A letter will bring Bulletin No. 150 which illustrates the complete line . . . or better yet let a Stroman Metallurgist consult with you on their application in your plant.

STROMAN "JC" TILTING TYPE FURNACES FOR MELTING BRASS. Fastest Melting . . . from 15 minutes up . . . lowest fuel consumption . . . always perfect metal for castings . . . capacities from 400 pounds to largest requirements.

STROMAN REVERBERATORIES for the melting of Unlimited Capacities of Aluminum, Zinc or Brass. Excellent for Smelters or Billet Casters.



STROMAN "RF" BARREL TYPE POWER TILT FURNACE for Brass, Aluminum, Iron and various smelting operations. Sizes range up to 20,000 pounds brass.



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STROMAN IRON POT AND CRUCIBLE STATIONARY DIP-OUT FURNACES FOR MELTING AND HOLDING. For Aluminum, Lead, Zinc and other white metal alloys. Rugged construction with ample combustion room to prevent direct impingement of flame on pot. Available with or without hoods.

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Circle No. 163, Page 7-8

M. HOLTZMAN METAL CO.

SMELTERS AND REFINERS
SINCE 1900

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GUARANTEED Brass, Bronze and ALUMINUM INGOT to your specifications IMPROVED WITH FACTOR "X"!
Send us a sample order! If you want to improve the quality of your finished products at no additional cost . . . let us show you what HOLMCO ingot, improved with Factor "X" can mean to you!

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Circle No. 164, Page 7-8

FOR BETTER CASTINGS...
UNIVERSAL
refractory gating components

Splash Cores
Strainer Cores
Pouring Tubes

Determine proper gating faster, eliminate slag inclusions, stop rejects, reduce cleaning room time, and lower production costs. UNIVERSAL *refractory* gating components will help you do this, and at less cost than producing your own from sand. Send specifications for price and delivery quotations, or call SAndusky 4631

WRITE TODAY FOR CATALOG LISTING SPECIFICATIONS OF STANDARD GATING COMPONENTS

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Circle No. 165, Page 7-8

patent review

MELVIN NORD
Consultant in Law and Engineering

Core Blower Improvement

A core blower has been adapted to the production of a variety of different cores in a continuous production run without adjustment of the machine. The mechanism is automatic and will both position the individual core box top beneath the blow plate at the blow station and at other stations hold the top of the box clear of the core box proper. *Pat. No.* 2,791,012 *issued May* 7, 1957 *to Leon F. Miller and assigned to Osborn Mfg. Co.*

Blow-Squeeze Molding

Mold or core blower also applies a squeeze to total area, or to a limited area, of the mold or core. The mechanical squeeze is effected automatically as one step in the operational sequence. Squeezing compacts sand more firmly. *Pat No.* 2,791,013 *issued May* 7, 1957 *to John H. Demmler.*

New Alloy

A method of treating white iron castings to produce malleable iron with annealed spheroidal graphite has been patented.

The process consists of heating castings and directly quenching to impart a martensitic structure to the metal, and graphitization annealing at a temperature higher than that employed in the heating step, this temperature being maintained until total disappearance of the cementite dissolved in austenite at the annealing temperature. *Pat. No.* 2,791,526 *issued May* 7, 1957 *to Lucien J. Peras, assigned to Regie Nationale des Usines Renault.*

Other Patents

Apparatus for producing shell molds. Patent No. 2,778,073, *Poygram Casting Co., Ltd.*

Shot compacting in the shell molding process. Patent No. 2,778,077, *Industrial Development Bank.*

NARCOLINE NARCOLINE NARCOLINE

Slag-Resistant Plastic Refractory

NARCOLINE Assures Cleaner Castings

It successfully resists the erosive and corrosive action of metals and slags, eliminating refractory inclusions from the casting.

NARCOLINE Facilitates Metal Flow

It resists graphite burnout under operating conditions, and maintains a lasting lubricated surface for easy metal flow.

NARCOLINE Assures Easy Slag Removal

It resists the wetting action of molten metal and slag, permitting ladles to be cleaned of solidified metal and slag with little effort.

NARCOLINE Easy to Install

It can be rammed to any desired shape with mallet or air hammer. Requires no special training to install.

Send for bulletin No. 106 Rev.

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Circle No. 172, Page 7-8

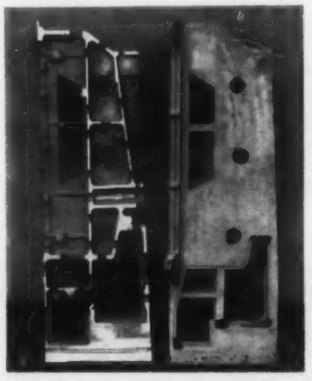
New Aluminum Alloy Meets Challenge of Jet Aircraft

■ A new high strength aluminum alloy, Tens-50, is enabling foundries to invade the forging field. One such foundry, Rayson Casting and Mfg. Co., Gardena, Calif., is casting pylons for North American Aviation's F-100 Super Sabre in the alloy.

Another F-100 part, which formerly cost $350 to mill from bar stock is being cast for approximately $15 and has the same weight to strength ratio, according to Rudi Ramos, vice-president of Rayson.

Quantity production of the F-100 pylon castings is being achieved with an x-ray reject rate of less than one per cent. A representative range of properties for the castings being made are: 46,600-48,550 psi tensile strength; 36,000-38,650 psi yield; and 3 to 5 per cent elongation.

Tens-50 was developed by Navan Products, Inc., Santa Monica, Calif. Composition range is essentially 7.6 to 8.6 per cent silicon; 0.4 to 0.55 per cent magnesium; 0.1 to 0.3 per cent



beryllium; 0.1 to 0.2 per cent titanium; balance, aluminum.

■ For more information on this alloy circle no. E, Reader Service Card, pages 7-8.

Grinding Problems With Zirconium and Titanium

■ For the safety of personnel and plant, dust exhaust equipment is virtually a must when titanium and zirconium metals are being ground.

Researchers of Electro Refractories & Abrasives Corp. point out dust from either of these two metals will burn like a magnesium flare when subjected to ordinary flame. Even during normal grinding operations, titanium and zirconium will give off sparks that glow with almost blinding intensity. To cope with this glare, dark-tinted safety glasses are recommended for adequate eye protection.

PERMABRASIVE®

is the only pearlitic malleable shot and grit on the market!

FREE EXPENDABLE PALLET PACK

Forty 50 lb. cartons in one master pack: easy to store, easy to inventory, easy and safe to handle. **No Extra Cost to you.** (Also in conventional 100 lb. or 50 lb. bags.)

FREE TEST SAMPLE KIT

A free, no-obligation, lab analysis on your blastcleaning efficiency. See where your money goes. **No Cost to you.**

Result? More durable structure, greater resistance to breakdown, longer life, greater cleaning ability, lower abrasive costs, lower maintenance costs, faster cleaning.

●**PERMABRASIVE is better than steel shot and grit** because it contains more cutting carbides producing a much, much faster cleaning time; add its lower price and you have an obvious savings in costs!

●**PERMABRASIVE is better than ordinary annealed shot and grit** because it has more cutting carbides and less graphitic carbon—because it has less phosphorus content indicating a resistance to breakdown—and because the cutting carbides are held in a unique ductile matrix; this means a much, much longer abrasive life with an obvious savings in costs!

USERS SAY

"Using (blank) annealed abrasive, the consumption per wheel-hour was 18.4 lbs.; with PERMABRASIVE the consumption was 14.7 lbs. . . . a reduction of 20.1%."

"We checked the performance of PERMABRASIVE vs two brands of Steel Shot. Results:

PERMABRASIVE . . . $.81, Steel Shot—Brand A . . . $1.48, Steel Shot—Brand B . . . $1.04."

"Used PERMABRASIVE in test against mixture of Steel and Annealed Shot. Abrasive cost per wheel-hour with PERMABRASIVE was $.93, against $1.17 for the mixture . . . a savings of 20.5%."

NATIONAL METAL ABRASIVE COMPANY
3560 Norton Rd. • Cleveland 11, Ohio
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Sole manufacturers of
®*Permabrasive and* ®*Controlled "T" abrasives.*

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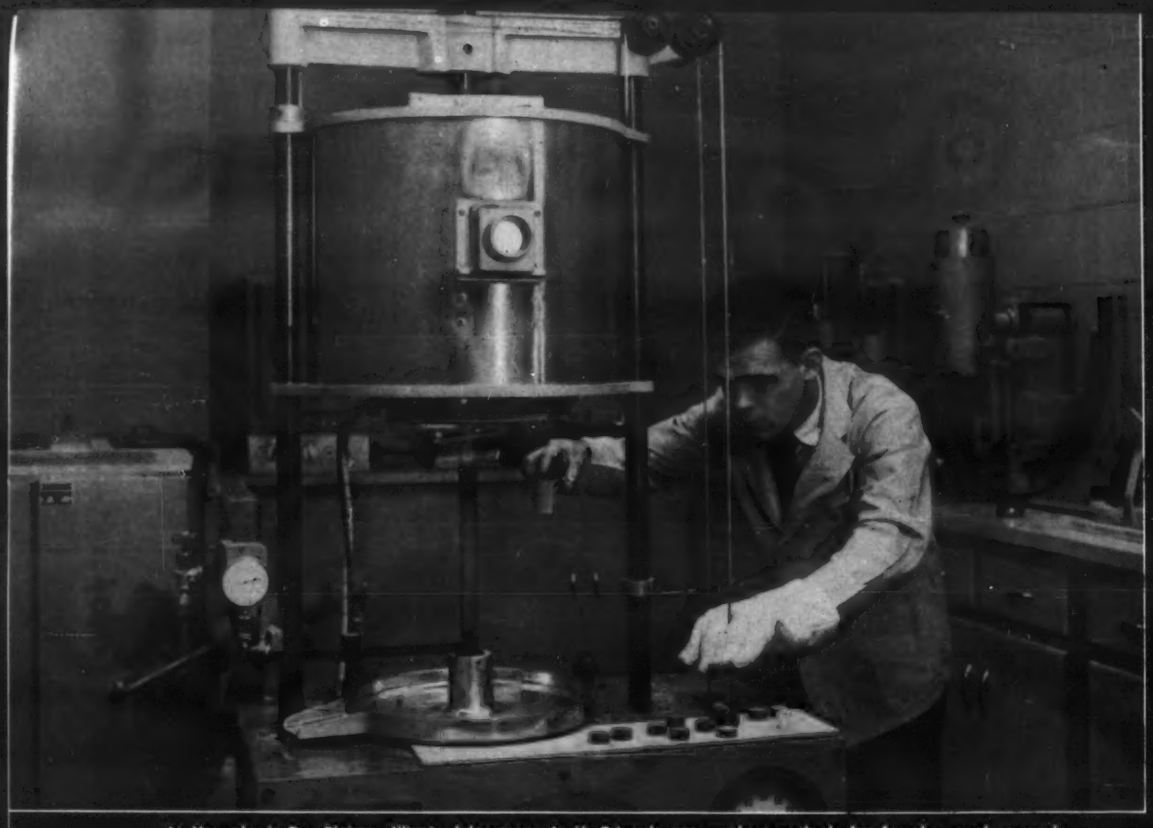
Circle No. 166, Page 7-8



At Magcobar's Des Plaines, Illinois, laboratory, A. H. Zrimsek uses modern methods for foundry sand research.

SCIENCE and SAND

. . . Recipe For Progress

In new laboratories at Des Plaines, Houston and Greybull Magcobar technicians are busy with silica, bentonite, water and a host of other ingredients, taking the guesswork out of sand formulas. Applying modern research methods, these scientists are *proving* the "hows" and "whys" of foundry sand practice.

Magcobar invites the technical and research groups of the American Foundries to use Magcobar facilities for the solution of various industry-wide problems relating to sands.

Write Des Plaines for our latest foundry technical bulletins. Look to Magcobar, producers of YELLOWSTONE bentonite, for further revealing recipes for progress.

Magcobar
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BENTONITE

MAGNET COVE BARIUM CORPORATION
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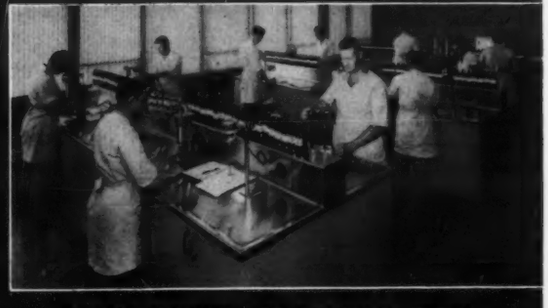

Magcobar technicians in the company's big research laboratories in Houston strive for constant improvement of Magcobar products.

This Magcobar plant at Greybull, Wyoming, where YELLOWSTONE is mined and processed, is the world's largest producer of bentonite, and includes a complete quality-control laboratory.

obituaries

James R. Cardwell, 84, former president, Cardwell Westinghouse Co., Chicago, died December 8. He was the inventor of an improved railroad brake shoe, and a draft gear, a form of shock absorber which reduced shock damage in coupling of cars.

A resident of Chicago since 1893, Mr. Cardwell set up the Cardwell Mfg. Co., and organized the Union Draft Gear Co. In 1930 he took in the Westinghouse Draft Gear Co., changing his firm's name to Cardwell Westinghouse Co. He was a director of the Diamond T Motor Co., Allied Mills Co. and Allied Steel Castings Co.

Robert G. Leckie, resident comptroller, Chevrolet Div., General Motors Corp., was killed in an automobile accident in Saginaw, Mich., Nov. 9. He had been associated for 38 years at the Grey Iron Foundry, Chevrolet Division and was resident comptroller for 21 of those years.

Stanley B. Davies, 69, president, Royer Foundry & Machine Co., Kingston, Pa., died Sept. 27. He was affiliated with the company for 33 years, serving first as treasurer, later as general manager.

Dr. Ernst Muller, vice-chairman of board of directors, Georg Fischer Aktiengesellschaft, Schaffhausen, Switerland, died recently after 50 years' service with the company.

Du Pont Develops Niobium for Aircraft and Missiles

■ Critical design problems in jet engines, guided missiles, and atomic reactors are being met by the development of niobium metal in Du Pont laboratories.

In pure form, niobium is extremely ductile when kept free of nitrogen, hydrogen, or oxygen. For example, a one-lb, three-quarter in. ingot of the metal can be cold-rolled into a thousandth-in. thick foil without annealing.

Niobium alloys, because of their strength and oxidation resistance, are adaptable to ultra-high-speed aircraft and gas turbine engines; also jet and missile applications.

Circle No. 167, Page 7-8

Classified Advertising

For Sale, Help Wanted, Personals, Engineering Service, etc., set solid . . 25c per word, 30 words ($7.50) minimum, prepaid.

Positions Wanted . . 10c per word, 30 words ($3.00) minimum, prepaid. Box number, care of **Modern Castings,** counts as 10 additional words.

Display Classified . . Based on per-column width, per inch . . 1-time, $18.00; 6-time, $16.50 per insertion; 12-time, $15.00 per insertion; prepaid.

Help Wanted

CLEANING ROOM SUPERINTENDENT: Must have supervisory experience and be completely familiar with all phases of cleaning room operations for a miscellaneous steel jobbing foundry producing castings up to 10,000 pounds. Excellent opportunity for an aggressive qualified man with a modern and progressive foundry located in the middle west producing 600-700 tons per month. Advise full particulars including salary requirements. **Box E-1, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FOUNDRY LAYOUT

Leading manufacturer of foundry equipment located in Chicago requires man with 5 to 10 year's experience in foundry layout and sand-handling systems to prepare schematic foundry equipment layouts to suit customer conditions.

Position offers excellent opportunity to use and further expand your foundry experience through plant surveys, engineering, sales, and customer contacts.

Submit personal resume covering experience, references, age, education and salary requirements. **Box E-2, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

Precision casting Foundry Superintendent, high alloy. To take charge of pilot plant operation to develop and evaluate new process. Man in 30-40 age bracket preferred. Location—New Jersey. Salary open. **Box No. E-3. MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

Engineering Service

SESSIONS ENGINEERING CO.

Consulting Foundry Engineers
Modernization, Processing Layouts
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Consultants
Exclusively serving the foundry industry since 1930
Mechanization—Modernization
Labor Relations—Incentives—Systems
Cost and Production Control
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3110 W. Fond du Lac Ave., Milwaukee 10, Wisconsin

Wanted to Buy

TRANSACTIONS AFS back volumes and sets—wanted to buy for cash, also other scientific and technical Journals. **A.S.F. ASHLEY, 27 E. 21st Street, New York 10, N.Y.**

Wanted—Osborn Roto-Lift Molding Machine Model 3161. Box D-90, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.

For Sale

FOR SALE—Pig Machine—Conveyor type motorized pig machine. Pours 25—40# steel pigs. Details on request.
CRUCIBLE STEEL CASTING COMPANY
2850 So. 20th St.
Milwaukee 15, Wis.

Molding Machine: Herman 6000# capacity, jolt-roll-draw in operating condition. **Asking $2,900.00 FOB Pottstown Machine Co., Pottstown, Pa. (Phone 37, H. H. Houston).**

FOR SALE-LEASE or Joint Venture. Going non-ferrous specialty foundry and polishing shop. Two oil furnaces, established eighteen years. Good brick building. **HODGE & SHERMAN AGENCY, 304 First National Bank Bldg., Elkhart, Indiana.**

FURNACES FOR SALE

10 used Heat-Treating Furnaces, and two 7-ton gantry cranes, good condition, priced to sell.

BAER STEEL PRODUCTS. INC.
Box 1428
Boise, Idaho

Positions Wanted

Foundry Manager: 32 years experience covering grey cast iron, malleable cast iron, pearlitic malleable cast iron and cast steel. Experience in automotive, agricultural, stove plate and enamelware castings. Work background, manager, foundry consultant, sales engineer, operating foreman and metallurgist. Aggressive. Salary open. **Box E-4, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

PERMANENT MOLD DESIGNER or castings buyer. Aluminum, copper-base alloys and magnesium experience. Would relocate. **Box E-5, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FOUNDRY EQUIPMENT FOR SALE

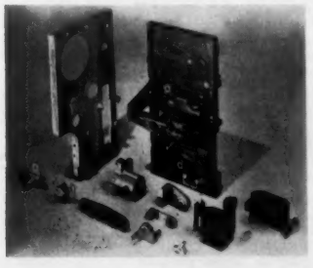
1—Herman Molding Machine, Jolt—Roll—Draw, 4,000# series with 36" x 72" turnover plate—Oil and air tanks.
1—Centrifugal Casting Machine—complete with motor—5' Diameter, 42" high, 36" flask capacity.
1—Feeder Syntron 24" x 74" Type F-46, Style FO-726.
2—Squeezers—Osborn #212-PJ, 12" cyl. staty type.
1—Bumper—Osborn 36" x 48" Table.
1—Screening Unit—Simplicity 2' x 6' with motor.
1—Exhaust Fan—American Air Filter Type H 1400 CFM, 2200 RPM.
2—Stand Grinders—Double wheel 20" wheel with 3600 RPM. Motors.
1—Surface Grinder—Gardner #226 26" wet wheel.

The above equipment is slightly used and in good condition.

LOS ANGELES STEEL CASTING CO., 6100 S. Boyle Ave., Los Angeles 58, Cal.

here's how

■ Here's how **RCA** uses magnesium die castings in a portable 16mm motion picture projector. Total of 12 cast-



ings are used in case and mechanism of 33½ lb unit. Castings are purchased by RCA from jobbing shops.

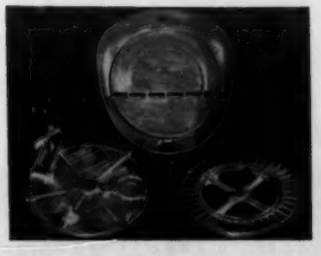
■ Here's how **Dependable Pattern Works,** Huntington Park, Calif., duplicates an existing wooden cope and

drag for a roll-over molding machine. Epoxy resin was used to cast 5 ft sq cope and drag. Core boxes for the job were also produced in epoxy.

■ Here's how **National Precision Casting Corp.,** Clifton Heights, Pa., casts

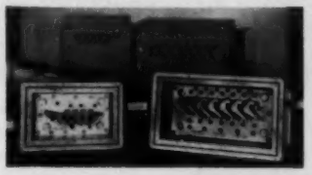
a steel aircraft part that was formerly a two-piece assembly. The investment casting process is used to produce the part as one piece in 4140 steel.

■ Here's how aluminum die castings are used in a home floor polisher produced by **Interstate Precision Products Corp.,** Anaheim, Cal. Turbine

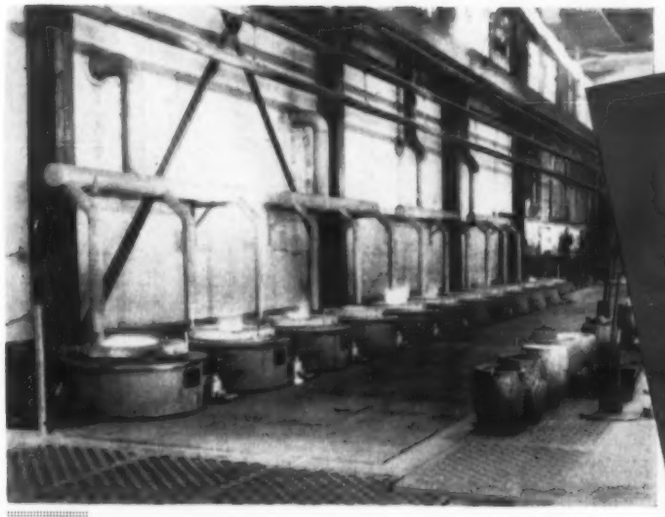


casting, lower right, has blades cast at 15 degree angle and has steel center post cast as an insert.

■ Here's how **Lebanon Steel Foundry,** Lebanon, Pa., reduced core cost and shutdown time for core box repair on a difficult job. Severe wear was encountered on metal inserts in core box for a louver blade casting until beryllium copper alloy inserts were placed in use. Core box design has



3/8-in. blow hole in 3/4-in. space between each insert, resulting in severe abrasion of sides of insert. Aluminum and chrome-plated iron inserts failed after 500 to 800 cores, beryllium copper inserts have produced 20,000 cores without showing wear.



A battery of gas fired, stationary Crucible furnaces at U. S. Naval Gun Factory, Washington, D. C. The pipes manifolded to each set of three furnaces supply air at one pound pressure. Proportional mixers assure constant gas-air ratio set for maximum fuel efficiency and proper furnace atmosphere.

Speed up melting with

CRUCIBLE FURNACES

is best and costs are lowest when CRUCIBLE FURNACES are operated at maximum efficiency

1. adequate fuel and air supply
2. proper fuel air ratio
3. furnace lining and covers in good condition

THESE FIRMS CAN TAKE CARE OF ALL YOUR REQUIREMENTS FOR

CRUCIBLE MELTING

Lava Crucible-Refractories Co.
American Refractories & Crucible Corp.
Electro Refractories & Abrasives Corp.
Ross-Tacony Crucible Co.
Vesuvius Crucible Co.
Joseph Dixon Crucible Co.

Have you seen the new " 'CRUCIBLE CHARLIE' says . . ." leaflets issued by Crucible Manufacturers Association? If not, ask your superintendent about this. He has a copy.

CRUCIBLE MANUFACTURERS ASSOCIATION

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Capital Goods Leveling Off Predicted by C.E.M.A. Panel

■ A sales forecasting panel composed of members of the Conveyor Equipment Manufacturers Association predicted at group's 24th annual meeting that capital goods business will level off and may decline slightly until the second or third quarter of latter part of 1958 would see new growth.

A new president, E. P. Berg, Link-Belt Co., Chicago was elected by C.E.M.A. members at the meeting held in the Grand Hotel, Point Clear, Ala, Oct. 12-15. He succeeds J. H. Walker, Fairfield Engineering Co., Marion, Ohio.

The new vice-president is J. B. Nordholt, Jr., Webster Mfg, Inc., Tiffin, Ohio; H. E. Murken, Hewitt-Robins Inc., Stamford, Conn., was elected treasurer; and L. J. Johnson, Mathews Conveyor Co., Ellwood City, Pa., is the new secretary.

Newly elected C.E.M.A. directors are: O. A. Johnson, Gifford-Wood Co., Hudson, N. Y.; L. E. Brill, The Jeffrey Mfg. Co., Columbus, Ohio; and E. E. Saperston, Mechanical Handling Systems Inc., Detroit.

Now Where Was That?

■ You will have no trouble locating articles in back issues if you write for the free index to 1957 issues of MODERN CASTINGS.

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